EFFECT OF ROW SPACING AND WEED CONTROL ON THE PERFORMANCE OF SOYABEAN (*Glycine max* (L.) Merrill) IN THE NORTHERN GUINEA SAVANNA OF NIGERIA

BY

Joseph Akimbo Yusufu SHEBAYAN

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for the degree of Doctor of Philosophy in Agronomy

DEPARTMENT OF AGRONOMY
FACULTY OF AGRICULTURE
AHMADU BELLO UNIVERSITY, ZARIA

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DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. It has not been presented before in any previous application for a higher degree.

Joseph A.Y. Shebayan

(CANDIDATE)

Date 14/10/98

The above declaration is confirmed

Prof. S.T.O. Lagoke

(MAJOR SUPERVISOR)

Date 14/10/98

CERTIFICATION

This thesis entitled "EFFECTS OF ROW SPACING AND WEED CONTROL ON THE PERFOMANCE OF SOYABEAN (*Glycine max* (L.) Merrill) IN THE NORTHERN GUINEA SAVANNA OF NIGERIA" by Joseph Akimbo Yusuf SHEBAYAN meets the regulation governing the degree of Doctor of Philosophy of Ahmadu Bello University, Zaria, and is approved for its contribution to scientific knowledge and literary presentation.

Prof. S.T.O. Lagoke
Chairman,
Supervision Committee

Date 14/10/98

Prof. O.O. Olufajo
Member,
Supervisory Committee

Date 26/10/98

Dr. W.B. Ndahi
Member,
Supervisory Committee

Date 16-10-98

Dr. E.B. Amans
Head,
Department of Agronomy

Date 23/11/98

Prof. J.Y Olayemi,
Dean,
Postgraduate school

Date 27/4/99

AHMADU BELLO UNIVERSITY,
ZARIA, NIGERIA

DEDICATION

TO THE SACRED HEART OF JESUS AND THE IMMACULATE HEART OF MARY.

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- J.A.Y Shebayan (1998)

ABSTRACT

Field trials were conducted in 1984 - 1988 wet seasons at Samaru in the northern Guinea savanna zone of Nigeria to study the response of soyabean (Glycine max (L.) Merrill) sown at inter-row spacings of 45, 60, 75 and 90cm to various periods of weed interference and to determine how best to control weeds in soyabean using a recommended herbicide.

Inter-row spacing of 45cm resulted in significantly lower weed cover score and cumulative weed weights than 75 and 90cm in all years, and had higher ground cover and taller plants than 75 and 90 cm inter-row spacing, however, the grain yields were not influenced by row spacing.

In the weed interference study, initial weed infestation of soyabean for only 3 WAS did not have a significant effect on any of the crop growth parameters and soyabean grain yield provided the weeds were subsequently removed. However weed infestation beyond 6 WAS significantly depressed crop vigour score, plant height, number of branches per plant as well as number of pods per plant, number of grains per pod, 1000-grain weight and grain yield compared with the crop kept weed - free throughout its life cycle.

To obtain soyabean grain yield comparable to that obtained in the plot kept weed - free till harvest it was necessary to keep the crop weed-free for the initial period of 6 WAS and later.

In the weed control trials the use of herbicides and hoe-weeding always resulted in significantly lower weed cover score and weed dry matter production compared with the weedy check. In addition supplementary hoe-weeding significantly reduced weed cover score, weed dry weight at harvest and cumulative weed dry weight than the weedy check but comparable to the hoe-weeded control in all years except in 1984. Each herbicide rate supplemented with one hoe-weeding resulted in lower weed score and weed dry weight than its corresponding rate not supplemented with a hoe-weeding but comparable to the hoe-weeded control. Except in 1984, when Galex at 1.5kg a.i/ha gave higher weed dry weight at harvest than Galex at 3.0kg a.i/ha, there were no significant differences in weed dry weight at harvest between both rates of the herbicide.

Soyabean in the herbicide treated plots gave higher vigour scores, percent ground cover, number of branches per plant, number of pods per plant, number of seeds per pod and 1000 grain weight than the unweeded check. The hoe-weeded control was comparable to the best herbicide treatment in these parameters. Galex at 3.0kg a.i/ha followed by SHW gave the highest grain yield but was comparable to the hoe-weeded control and Galex at 1.5kg a.i/ha followed by SHW.

In this study, uncontrolled weed growth throughout the crop life cycle resulted in 55.0 to 73.0% reduction of soyabean grain yield compared with the maximum obtained in the trial soyabean grain yield was positively correlated with

soyabean stand count, plant height, ground cover, number of branches per plant, pods per plant, grains per pod and 1000-grain weight and negatively correlated with weed dry weight. In the path analysis and the percentage contribution study number of pods per plant made the highest individual contribution to grain yield followed by 1000-grain weight.

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CHAPTER 1

1. INTRODUCTION

1.1 Production

Soyabean (*Glycine max* (L) merrill) is an important grain legume grown in the tropical and sub-tropical regions of the world. Total production is 94,843,000 MT from 52,417,000 ha. with United States America, Brazil and China being the three leading producers. In Africa, Nigeria had the largest land area of 160,000 ha devoted to its cultivation with a total production of 160,000 tonnes (FAO, 1993). Recent production figures have been shown to be 160,000 tonnes in 1994 and 1.24 million tonnes in 1995 (Anon., 1994 and 1995). Benue, Kwara, Kaduna and Plateau states and the Federal Capital Territory are the main areas of soyabean production in the country.

1.2 Uses

Soyabean is both an industrial and a food crop with a wide variety of uses. It has the highest vegetable protein content of 44%, with all the essential amino acids, making it an ideal alternative to animal protein for human consumption and compounding of livestock feeds. Among various crops, it has the highest level of the amino acid, lysine (6%), making it an ideal supplement for cereal, root and tuber crop meals noted for their low levels of this amino acid. Soyabean is a valuable protein supplement in infant foods, while soyaflour could replace up to 20% of other flours to produce more nutritious foods (Singh, 1987). It contains 92% of total

digestible nutrients and therefore superior to other legumes in supplying metabolizable energy. Soyabean is processed into "daddawa", a food seasoning product, and is also used as a substitute for melon ("egusi") in sauces. It contains 18 to 23% semi-drying oil whose high content of saturated fatty acids makes it ideal for domestic cooking and industrial manufacture of assorted products. Lecthin, a by-product of the soyabean oil industry, is used as a wetting and stabilizing agent in industrial products like paints, detergents and cosmetics. In soil conservation, the nitrogen-fixing ability of the crop and its fast canopy closure make it an ideal cover crop in the fragile and nutrient deficient savannah soils.

1.3 Production constraints

Increased awareness of the importance of soyabean and its processing for both human and livestock consumption have increased demands for the crop. The yields from farmers' fields however, remain at less than a tonne per hectare which is low compared with 2.2 and 2.5 t/ha obtainable in the United States of America (Anon., 1994) and experimental fields in the Nigerian savanna (Lagoke et al., 1991), respectively . Insufficient rainfall at grain filling stage, lack of improved high yielding varieties that are also less susceptible to shattering than the local Malayan variety, too wide spacing, lack of or insufficient fertilizer application and poor weed control have made increased yields difficult (Shebayan and Lagoke, 1986)

1.4 Weeds and weed control

Weed competition is one of the most important factors limiting soyabean yield. In the Nigerian savanna weed competition throughout the crop life cycle caused yield losses of 30% to 75%, with an average of 53% (Shebayan and Lagoke, 1987; Lagoke and Shebayan, 1996).

Weeds compete directly with soyabean for light, nutrients and moisture and may interfere directly through production and release of allelopathic chemicals that inhibit crop growth (Lolas and Cobble, 1982). Weeds serve as alternative hosts to pests and diseases of soyabean, and reduce quality of soyabean through increased foreign matter, moisture content and seed splitting (Anderson and McWhorter, 1976).

The degree of interference between crops and weeds is directly proportional to the density and duration of the weed infestion in the crop. These factors have been investigated for a number of specific weeds in soyabean (Thurlow and Buchanan, 1972; Oliver et al., 1976; Eaton et al., 1973; Cobble and Ritter, 1978; Cobble et al., 1981). In general, research has shown that a period of 4 to 6 weeks without weed competition at the beginning of the growing season will allow production of maximum yields. Any weed emerging in the crop after this initial weed-free period will not affect the potential yield. The onset of significant interference with soyabean yield potential is highly correlated with light interference (Cobble et al., 1981.).

The effective and efficient control of weeds, among other factors, constitute an important agronomic problem in soyabean production. In Nigeria, hoe-weeding, which is the most common method of controlling weeds in the crop, is labour-intensive, expensive and inefficient hence the need for chemical weed control which appears to be a better alternative. The use of herbicides to control weeds in soyabean has been found to be profitable (Shebayan and Lagoke, 1986). Chandra-Singh and Lagoke (1982) reported effective control of *Rottboelia* and other weeds and obtained high soyabean yield comparable to the hoe-weeded check with Galex, a prorietory mixture of metolachlor plus metobromumon at 1.0 + 1.0 kg a.i/ha, followed by supplementary hoe-weeding at 6 WAS. Futhermore good yields were obtained from the crop when treated pre-emergence with pendimethalin plus metobromuron at 1.5 + 1.0 kg a.i/ha followed by haloxyfop-ethoxyethyl at 0.25kg a.i/ha. They observed that without supplementary weed control, either by herbicide or hand weeding, none of the treatments effectively controlled the weeds and therefore gave low yields. Subsequent work with Galex at 2.5 kg a.i/ha, Codal at 2.5 kg a.i/ha and metolachlor plus metribuzin at 1.25 + 0.5 kg a.i/ha confirmed the need for supplementing the pre-emergence herbicide with a hoe-weeding or a post-emergence herbicide (Shebayan and Lagoke 1988 and 1990).

In Nigeria, the recommended spacing for soyabean is 5 cm between stands on 75 cm wide rows or ridges. Farmers however,

sow the crop on ridges that are at least 90 cm to allow for mixed-cropping and hoe-weeding. Closer row spacings have been observed to increase the crop's competitive ability through earlier canopy closure and smothering of weeds with consequent increase in yield (Pal and Mansfield, 1982). Such closer row spacing might make it possible to achieve season-long weed control using the recommended or lower rates of the herbicides.

1.5 Objectives

The study was therefore initiated with the following objectives:

1) To determine the effect of period of weed interference and row spacing on the growth and yield of soyabean.
2) To determine the critical period of weed competition in soyabean.
3) To determine the effect of weed conctrol treatments and row spacing on the growth and yield of soyabean.

CHAPTER 2

LITERATURE REVIEW

2.1 Yield Losses Due to Weeds

Weeds reduce soyabean grain yield by shading the crop and competing with it for moisture and soil nutrients. Nester (1970), working in Arkansas, U.S.A, reported that unchecked weeds reduced soyabean yields by 50% or more. Under similar conditions, Hayes and Slack (1978) reported that heavy weed competition reduced grain yield by 34 to 38%. In semi tropical conditions in India, Rana and Chand(1978) reported 10,24 and 60% yield losses when soyabean was hoe-weeded thrice, twice and once respectively, compared with the best herbicide treatment. In Korea, Pyon and Lee (1980) reported 42% yield loss from the most susceptible variety.

Nangju (1980), working under humid tropical conditions in Ibadan Nigeria, reported that weeds reduced seed quality and caused seed yield loss of 34% when maturation occurred during the wet season. Akobundu (1980) in the same ecology put the yield loss at 60%. Ayeni (1985) in the Derived savanna ecological zone of Nigeria reported up to 75.6% yield loss from uncontrolled weeds, he attributed the higher yield loss due to weeds in the Deried savanna zone compared with 17% for the southern Guinea savanna to the higher proportion of broadleaf weeds than grasses in the former ecological zone. In the northern Guinea savanna ecology where the proportion of grasses to broadleaf weed is the same, grain yield losses due

to weeds have been observed to range between 23 and 77% (Shebayan and Lagoke, 1986; 1988; Lagoke et al., 1991).

2.2 Effect of Weeds on Soyabean Growth and Yield Components

Weed competition affects soyabean growth and grain yield. Barrentine (1974) in the USA studied common cocklebur (*Xanthium pensylvanicum*) - soyabean competition in a Dundee silt loam soil and reported that a reduction in the crop stand occurred after 12 or more weeks of weed competition, while weed competition with the crop for up to 10 weeks and beyond increased crop height. James et al. (1974) measured several parameters of soyabean plant growth and found leaf area and shoot dry weights most affected by competition with common cocklebur. Within 30 cm of common cocklebur plant, soyabean leaf area and shoot dry weight were reduced by 19 and 15%, respectively compared with soyabean 105 cm away from the weed. The effects on leaf area and shoot dry weight lessened as the distance between the crop and weed widened. Soyabean grain yield declined by 0,10,25 and 47% due to weed presence 75 to 105cm, 45 to 75cm, 15 to 45cm and 0 to 15cm respectively, from a soyabean plant. A reduction in pod number per plant of 6,11,22 and 40% for the coresponding distances indicated accounted for most of the yield loss. In a series of studies on *Setaria faberii* competition in soyabean conducted earlier in the U.S.A, Knake and Slife (1962, 1964, 1965, 1968 and 1969) reported that 54,12 and 6 plants of *S. faberii* per 30cm row lowered soyabean yields by 28,18 and 10%, respectively.

Competition resulted in fewer pods per plant with little effect on beans per pod or bean size (Knake and Slife, 1962). These findings were corroborated by results from several other studies (Moolani et al., 1964; Eaton et al., 1969; Drennan and Jenning, 1977). Pyon and Kim (1978), in Korea, reported a reduction in the number of pods per plant and plant height due to weed competition; they also observed a positive correlation between the reduction in yield and reduction in number of pods per plant and plant height. Burnside (1979) reported that early weed removal aided soyabean stand establishment; seed weight and seed number per plant decreased as weed growth in creased. Young and Wyse (1980) also in the U.S.A, reported a reduction in the number of pods and seeds per plant with full season weed competition. In Japan, Nemoto et al. (1982) observed that increasing the weed-free period resulted in progressive increase in shoot and stem weight, diameter of the main stem, number of secondary branches, number of pods per plant, number and weight of seeds per plant and seed per stem ratio. In the weedy plots, soyabean plants were taller, produced longer internodes and had branches at right angles to rows.

2.3 Critical Period of Weed Competition

Wax and Slife (1967) in the U.S.A. reported that yields of soyabean kept weed-free for approximately one month after planting, did not differ significaty from those of the plots kept weed-free throughout the season. In the same place

Bergland and Nalewaja (1969) reported no significant differences in yield when weeds competed with the crop for up to 21 days after sowing before removal. Yields however, declined by 31% when removal was delayed for up to 49 days beyond which no further reductions were observed, thereby indicating that the critical period of weed competition was between 21 and 50 days. Knake and Slife (1969) observed that *S faberii* presence during just the vegetative phase had no significant effect on soyabean yield, significant yield reduction was only as a result of competition during the reproductive phase of the crop or when competition for light ensured. Vega et al. (1968) in the Philippines obtained optimum soyabean yields only when the crop was kept weed-free for up to 40 days after sowing. Hammerton (1972) in Trinidad reported that soyabean kept weed-free for a period of 6 weeks from sowing gave good yields.

Barrentine (1974) reported that maximuim yield without further weed control occurred when the weed, common cocklebur, was removed at 4 weeks, while yield reductions of 10, 36,40, 80 and 100% were obtained for 4, 6, 8, 10, 12 and 16 weeks of weed competition after emergence. Pyon (1978) in Korea reported that weed control for more than 6 weeks was necessary to get maximum yield, but relatively high yields were obtained with a weed-free period of 2 weeks after sowing. In Nigeria two weedings at 3 and 6 WAS have resulted in season-long weed control and soyabean yields comparable to the best weed

control treatments that gave season-long weed control (Shebayan and Lagoke, 1990;Lagoke and Shebayan, 1996).

2.4 Row spacing and Weed Competition in Soyabean

Studies have shown that weed control in soyabean is influenced by row spacing. Peters et al. (1965) reported that when herbicides were used, soyabean planted in 50 and 60 cm rows needed only one cultivation while those in 80 and 100cm needed more than one cultivation for good weed control and high soyabean yields. Soyabean in narrow rows equalled and sometimes outyielded that in wide rows while the crop canopy achieved full ground cover more rapidly in narrow rows than in wide rows. When herbicides suppressed early weed growth, less weedings were needed in the narrower than in the wider spacings. Kust and Smith (1969) similarly observed increased yields and weed control as row spacings decreased. They also reported that lower rates of linuron were required for comparable weed control as row spacing decreased.

Burnside and Colville (1964) observed that soyabean in 102cm wide rows offered less competition to mixed annual grass and broad leaf weed populations than in narrower spacings through late shading by the crop. Soyabean planted in narrow row spacing (51cm or less) increased yields partly due to better competition with weeds at an earlier stage of growth than those in wide rows but also due to more optimal distribution of plants and greater efficiency in use of light, nutrients and moisture (Burnside and Colville, 1964). Variety

"Ford" grown in 25,51 and 102 cm row spacing shaded the soil in between rows in 47, 58 and 67 days, respectively. Once the canopy closed and light penetration blocked, further weed emergence through the crop canopy was essentially stopped. Dougherty (1969) later confirmed that the shading of weeds by the quickly formed canopy of soyabean planted in narrow rows accounted for the more effective weed control than in wide rows. Wax and Pendleton (1968) encountered yield increases of 10, 18 and 20% for 76,51 and 25cm wide row spacings compared with 102 cm spacing due to rapid weed shading in narrower spacing. Dowler and Parker (1978) observed that although in weed control systems, length of wet season and weed flora were better determinants of weed number and size at harvest than row spacing, row spacing did influence period of weed emergence. In 50cm rows, weeds emerged for the first 6 weeks after planting compared to 7 weeks for 90 cm rows (Burnside et al., 1969).

Based on research results, Pal (1985) in Nigeria preferred planting the dwarf and compact Samsoy-2 soyabean variety at 50cm row spacing both for increased yields and effective weed suppression mid season. Anaele and Bishnoi (1992) in USA in a study on the effect of tillage, weed control method and row spacing on soyabean yield observed that soyabean yield of 4.0 t/ha from 45cm row spacing was higher than 3.13t/ha and 2.4t/ha from 60cm and 90cm row spacing. Weed infestation was also less at 45 cm than at 60 or 90 cm row spacings.

2.5 Chemical Weed Control

Herbicides offer a better alternative to weed control in soyabean than manual weeding. Wood (1970) had observed that commercial use of herbicides eliminated the need for cultivation for weed control in groundnut. Selective weed control in soyabean has been reported with several pre-emergence herbicides such as metolachlor, alachlor, metobromuron, metribuzin and terbutryne when used alone or in mixtures (Shebayan and Lagoke, 1986,1988; Buhari, 1980; Lagoke et al., 1991). However, the treatments have not been consistent in giving season - long weed control as they often require supplementary weed control which further increased the cost of production.

2.5.1 Amides

All the members of the group are derived from reactions in which the hydroxyl portion of the carboxyl group of an acid has been replaced by an amino group ($-NH_2$).

A major subdivision of the amide class of herbicides is the chloroacetamides. They have a monochlorinated methyl ($Cl-CH_2$) in the R-1 position. Members include alachlor (2 - chloro-2,6-diethyl-N-(methoxymethyl) acetamide) and metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxyl-1-ethyl) acetamide).

Chloroacetamides are readily absorbed by plants primarily by seeds and first node of germinating seedlings and appear to be translocated in the apoplast but symplastic movement may

also occur. These herbicides are readily absorbed by both the susceptible and resistant species (Jaworski, 1975). The degree of susceptibility of various weeds to chloroacetamides could be directly related to the length of time required to initiate the metobolism of these chemicals. Those species that are able to metabolize the chemical rapidly after absorption have only small concentration of the chemical present in the plant tissue at any one time. On the other hand, those species with delayed or slow metabolic capabilities accumulate relatively higher and thereafter lethal concentration (Jaworski, 1975). The basis for selectivity of the chloroacetamide herbicides could therefore be attributed to the ability of resistant plants to metabolize them at a fast rate to keep cellular levels below that required for growth inhibition in the leaves (Kearney and Kaufman, 1975). They primarily inhibit mitochondrial phosphorylation and reduce cell division in primary meristems (Audus, 1976). They also influence nitrogen metabolism nucleic acide and/or protein metabolism. Foliage applied amide damage takes the form of localized or general necrosis, while the soil-applied amides inhibit root elongation (Audus, 1976).

2.5.1.1 Metolachlor

Metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl-N-(2-methoxylethyl) acetamide is usually applied pre-emergence for selective weed control of weeds in field crops like maize, cowpea, cotton, yam, soyabean and some horticultural crops

including tomatoes and peppers (Uwannah, 1982; Adigun, 1984; Adigun et al., 1987, 1 5; Lagoke et , 1983; Tijani, 1985; Sulaiman, 1985; Adejo , 1988; Lag et al 1986).

Metolachlor, like other members of chloroacetamide is a growth inhibitor especially that of root elongation. Germinating monocotyledonous seedlings absorb most of the metolachlor through the shoots just above the seed, while dicotyledonous ones seem to absorb this herbicide through both shoots and roots. While studies indicate that there can be several sites of action for chloroacetamides, depending on weed species, method and time of application as well as concentration, the primary site of action of metolachlor is inhibition of protein synthesis in germinating seeds (Anon., 1979).

It has been reported that metolachlor is mainly active on grasses and sedges at the rate of 1.0 to 2.5kga.i/ha depending on soil and climatic conditions (Martin and Worthing, 1977). However, a broader spectrum of weed control to include broad leaved weed species is possible if metolachor is combined with other herbicides (Dill and Dumford, 1978; Peak, 1980; Lagoke et al., 1982).

At Mokwa, Southern Guinea savanna of Nigeria, metolachlor at 1.5kga.i/ha effectively reduced weed infestation till 8 WAS and resulted in higher soyabean yield exceeding the hoe-weeded control. Similarly, at Yandev in the same ecology, the crop tolerated metolachlor at 3.0kg../ha which gave comparable

yield to the hoe weeded check and effectively controlled the weeds (Anon., 1982). Shebayan et al (1986) reported acceptable weed control and good soyabean grain yield through pre-emergence application of metolachlor plus terbutryne (Igran Combi) at 1.33 + 0.67kga.i/ha. A similar performance from the mixture of metolachlor with the same rate of terbutryne as well as the mixture with promethryne at 1.5 + 1.5kga.i/ha and diuron at 1.0 + 0.25kga.i/ha had earlier been reported at Samaru (Anon., 1982). Shebayan and Lagoke (1990) also reported good weed control and high soyabean yields from metolachlor plus metribuzin at 1.25 + 0.5kga.i/ha.

2.5.2 Substituted Urea

The substituted ureas are a large group of herbicides, with the phenylureas being one of the most widely used in tropical agriculture. All members are derived from the urea molecule. The urea herbicides vary in water-solubility from the moderately soluble fenuron (3.9g/l at 25°C) to the very slightly soluble chloroxuron (3.7mg/l at 20°C). Similarly the herbicidal properties vary greatly among members of this group. Generally the urea herbicides are photosynthesis inhibitors. They interfere with the photolysis of water during photosynthesis and nitrogen metabolism during photosynthesis in susceptible plants. At normal doses they are selective herbicides that cause chlorosis or yellowing, followed by necrosis in susceptible plant species. They are mainly soil-residual in action and are absorbed by roots of plants into

the xylem system through which they are transported to the leaves. Translocation in plants is apoplastic even when foliar uptake has taken place (Bayer and Yamaguchi, 1965; Geissbuler et. al., 1975). Selectivity in many plant species is through differential metabolism coupled with differential uptake and translocation (Swanson and Swanson, 1968; Osgood et al., 1972). The urea herbicides are readily adsorbed by soil colloids and are not easily leached from treated soil. They more effective on broadleaved weed seedlings than on grasses. Metabolism of phenylurea herbicides occurs readily in both plants and soils, and involves enzymes and micro-organisms, respectively (Gessbuler et. al., (1975).

2.5.2.1 Metobromuron

Metobromuron (2-4-(4-bromophenyl)-4-methoxy-1-methylurea) has a water solubility of 330ppm and an acute oral LD_{50} of 330mg/kg (Glenn et al., 1975). Metobromuron may be applied pre-emergence alone or in mixture with other herbicides for a season-long control of many annual grasses and certain broadleaved weeds in crops such as cowpea, soyabean, groundnut, sunflower, tobacco, onion, potatos, pepper and tomatoes (Usoroh, 1977; Lagoke et al., 1983). This herbicide is absorbed through the root and leaves.

In Nigeria metobromuron has mainly been used in mixture with other herbicides for broadspectrum weed control in soyabean. Anon. (1982) and Shebayan et al. (1986) in the northern Guinea savanna ecological zone reported acceptable

weed control and good soyabean grain yield from pre-emergence application of a mixture of metobromuron and metolachlor at 1.25 + 1.25kg a.i/ha. Shebayan and Lagoke (1987) observed that pre-emergence application of metobromuron plus metolachlor at 1.5 + 1.5kg a.i/ha effectively controlled annual grasses, broadleaved weeds and sedges and ensured season-long weed control and high grain yield whether supplemented with hoe-weeding at 6WAS or not.

2.6 Supplementary weed control

Several investigators have reported the need to supplement herbicides applied pre-emergence such as alachlor, metolachlor, diuron, prometryne, metobromuron and their mixtures, with hoe-weeding for effective season-long weed control in various field and horticultural crops as well as their mixtures such as maize -okra (Adejonwo et al., 1987) maize-pepper (Bakut, 1985), potato (Bulus, 1987) cowpea (Akobundu, 1978,1980,1982,1984) groundnut (Adeleke, 1984) and soyabean (Shebayan and Lagoke, 1988). Chandra-Singh and Lagoke (1982) reported effective control of Rottboelia and other weeds and high soyabean yields comparable to the hoe-weeded check with Galex at 2.0 kg a.i/ha followed by supplementary hoe-weeding (SHW) at 6 WAS. The mixture of pendimethalin with metobromuron at 1.5 + 1.0kg a.i/ha followed by haloxytop-ethoxyethyl at 0.25kg a.i/ha also gave good weed control and grain yield. They observed that without SHW or supplementary post-emergence herbicides none of the pre-emergence treatments

effectively controlled the weeds, consequently resulting in low grain yields. Shebayan and Lagoke (1990) reported equally season-long weed control when pre-emergence herbicides were supplemented with a hoe-weeding or post-emergence blanket application of imazaquin at 0.2kg a.i/ha. Good weed control and high crop yields were reported when half the rates of herbicides applied pre-emergence (Galex at 2.5kg a.i/ha, Codal at 2.5kg a.i/ha, and metolachlor plus metribuzin at 1.25 + 0.5kg a.i/ha) were applied pre-emergence to the weeds at 3 WAS (Shebayan and Lagoke, 1988)

CHAPTER 3

MATERIALS AND METHODS

3.1 Description of Experimental sites

Field experments were conducted on the farm of the Institute for Agricultural Research, Samaru (11° 11'N, 0 7° 38 'E and 686 m above sea level) in the northern Guinea savannah zone of Nigeria. The experimental field used in 1984, 1985, 1986 and 1988 were cropped in the preceeding years with maize, millet, sorghum, maize and cotton, repectively.

Each year, 10 random soil samples were taken (0-15cm) from the experimental sites before land preparation. The composite soil sample was analysed. Details of the physico-chemical characteristics are contained in Table 1. The soils were sandy loam, with good drainage but moderately low in N and P content. The sites had a slope of less than 1%.

The meteorological data collected were total and mean monthly rainfall as shown in Tables 2 to 3. In all years the rainfall intensity and distribution was adequate for soyabean production. The common weed species identified at the sites are given in Table 4.

Table 1. Physico-chemical characteristics of soils (0-15cm) taken from the experimental sites

Soil properties	1984	1985	1986	1987	1988
Physical properties					
Sand (%)	52.00	50.00	52.35	53.30	48.60
Silt (%)	32.00	30.35	32.00	34.80	36.00
Clay (%)	16.00	17.65	15.65	11.90	15.40
Textural Class	S A N D Y			L O A M	
Chemical properties					
PH in water	5.40	5.15	5.90	5.10	5.10
PH in 0.01m $CaCl_2$	4.60	4.85	5.70	4.55	4.70
Organic carborn (%)	0.65	0.60	0.70	0.61	0.44
Total nitrogen (%)	0.05	0.07	0.02	0.07	0.06
Available P (PPm)	10.40	8.20	7.00	6.53	6.35
Exchangeable cation (meq/100g soil)					
K	0.25	0.18	0.21	0.16	0.16
Mg	0.81	0.73	0.47	0.21	0.22
Ca	3.10	2.50	3.20	3.85	4.30
Na	0.33	0.22	0.24	0.76	0.50
CEC	10.90	6.10	3.80	7.35	7.90

3.2 Cultural Practices

3.2.1 Land preparation and fertilizer practices

The experimental fields were ploughed and harrowed two weeks later. Fertilizers at the rate of 30kg N, 60kg P_2O_5 and 30 kg K_2O/ha were applied using 200kg of 15-15-15 N.P.K compound and 150kg of single superphosphate. To ensure even distribution, the total fertilizers were divided into four equal parts and the field into four equal blocks. To each block of the field one part of the fertilizer was manually broadcasted.

The whole field was then re-harrowed before planting.

3.2.2 Crop Variety Characteristics

The recommended soyabean variety, "Samsoy-2" used in the study is a cross between Malayan (a local variety) and CNS (improved variety). The plant is short and stout with a determinate growth habit. It has yellow and large seeds and bears pods in clusters well above the ground. It matures in 100 to 120 days. It is moderately susceptible to cercospora leaf spot and bacterial pustule diseases and suscptible to pod-sucking bugs and leaf-eating beetles. It is also moderately resistant to shattering.

Table 2. Mean monthly rainfall (mm) at Samaru with deviation from the long term (1974-1987) mean in parenthesis

Year	May	June	July	August	September	October	Total
1984	98.8 (-23.7)	55.4 (-79.4)	173.8 (-34.4)	158.1 (-75.3)	189.0 (+33.4)	177.5 (+129.6)	852.7 (-49.8)
1985	140.7 (+18.1)	142.2 (+7.4)	313.1 (+104.9)	256.3 (+32.9)	163.3 (+7.7)	3.3 (-44.6)	1018.9 (+126.4)
1986	59.1 (-63.5)	82.0 (-52.8)	293.6 (+85.4)	332.1 (+88.7)	205.7 (+50.1)	0.0 (-47.9)	962.5 (+60.0)
1988	94.4 (-28.2)	133.2 (-1.6)	181.5 (-26.7)	402.5 (+169.1)	192.3 (+36.7)	114.7 (+66.8)	1118.6 (+216.1)

Table 3. Total rainfall (mm) received during the period of trial, 1984- 1988 wet seasons

	1984	1985	1986	1988
May 1-10	20.6	27.1	11.2	Trace
11-20	25.0	14.7	18.4	35.4
21-31	14.3	99.2	29.5	59.0
June 1-10	0.0	8.5	35.3	47.3
11-20	38.5	61.5	22.6	17.2
21-30	10.6	72.2	24.1	68.7
July 1-10	18.9	143.6	61.1	50.8
11-20	66.4	76.2	40.9	48.2
21-31	88.4	93.3	93.3	82.5
August 1-10	82.1	95.7	50.6	100.4
11- 20	32.1	75.7	49.9	107.9
21- 31	45.5	33.3	22.6	194.2
September				
1-10	62.3	52.5	56.4	76.5
11-20	27.0	75.4	81.2	71.0
21-31	149.7	35.4	75.3	23.8
October 1-10	124.5	1.1	0.0	114.7
11 - 20	53.0	2.2	0.0	0.0
21 - 31	0.0	0.0	0.0	0.0

Table 4: Common weed species at the experimental sites and their levels of infestation

Name of weed	level of infestation 1984	1985	1986	1988
Grass weeds				
Digitaria ciliaris (Ret) kock	XX	XX	XX	XX
Cynodon dactylon (L.) pers	XX	XX	XX	XX
Dactyloctenium aegyptium (L.) Beauv.	X	X	X	X
Echinochloa colona (L.) Link	X	X	X	X
Eleusine indica (L.) Gaertn	X	XX	X	XX
Chloris pilosa (L.) Link	X	XX	X	X
Brachiaria lata Hubb (Schum)	X	X	X	X
Broadleaved weeds				
Vernonia galamensis (L.) Cass Less	XXX	XXX	XXX	X
Acanthospermum hispidum Dc	XXX	XX	X	XX
Amaranthus viridis (L.)	X	X	X	X
Portulaca oleracea (L.)	XX	X	X	X
Crotalaria retusa	X	X	X	X
Trianthema portulacastrum	X	X	X	X
Sedges				
Cyperus rotundus (L.)	XXX	XXX	XXX	XXX
Cyperus esculentus (L.)	XXX	XX	XX	XX
Finbristylis hispidula	X	X	X	X

X = low infestation (less than 40% frequency of occurrence)
XX = moderate infestation (40 - 57% frequency of occurrence)
XXX = high infestation (over 60% frequency of occurrence)

3.2.3. Sowing and spacing

The soyabean seeds were dressed with Fernasan D at the rate of 10g of the chemical to 3kg of seed before planting to protect the seeds from soil borne pests and disease.

Soyabean seeds were planted immediately by dibbling two seeds per stand on 22-24, 26-28, 23-25, and 20-23 June, 1984, 1985, 1986 and 1988, respectively. The seeds were planted 2 to 3cm deep on the flat seedbed at spacings indicated for each treatments.

3.3 Treatments and experimental design

The trials were laid out in a split plot design and replicated four times. The four inter-row spacings were alloted to the main plots and the period of weed interference or herbicide treatments to the sub-plots. The planting arrangements involved the adjustment of both inter-row and intra-row spacings to arrive at a constant plant population of 266,666 plant/ha as shown in Table 5 and 6. The gross plot size was 4.0m long and 4.5m wide giving 6,7,9, and 12 rows in the 90,75,60 and 45cm inter-row spacings, respectively. The net plot consisted of 4,5,7, and 10 three meter long inner rows for the 90,75,60 and 45cm inter-row spacings, respectively.

In the weed interference trials the sub-plots were alloted ten periods of weed interference (Table 5). In the first set of treatments, plots were kept weed-free for 3,6,9 and 12 WAS, while in the second set of treatments, the crop

was kept weed-infested initially for the corresponding periods stated above. Two control treatments in which the plots were kept weed-free and weed infested until harvest were also included for comparisons.

In the weed control trials, the weed control treatments alloted to the subplots consisted of a proprietory mixture of metolachlor plus metobromuron (Galex) at 1.5 and 3.0 kg a.i/ha applied pe-emergence either alone or followed by a hoe-weeding. A hoe-weeded control (weeded at 3 and 6 WAS) and a weedy check were included for comparison with the herbicide treatments (Table 6).

Table 5: Details of treatments for weed interference study in soyabean at Samaru, 1984 to 1988 wet seasons

Treatments	Code
Spacing	
I_1 = 45cm x 8.33cm	
I_2 = 60cm x 6.25cm	
I_3 = 75cm x 5.00cm	
I_4 = 90cm x 4.17cm	
Period of Weed Interference	
Weed-free for 3 WAS[1]	*[2]
Weed-free for 6 WAS	*
Weed-free for 9 WAS	*
Weed-free for 12 WAS	*
Weed-free until final harvest	*
Weed-infested for 3 WAS	**[3]
Weed-infested for 6 WAS	**
Weed-infested for 9 WAS	**
Weed-infested for 12 WAS	**
Weed-infested until final harvest	**

1 WAS = Weeks after sowing
2. Plots kept weed-free initially for various periods and subsequently allowed to be weed infested until harvest
3. Plots allowed to be weed-infested initially for various periods and subsequently kept weed-free until harvest.

Table 6: Details of treatments for the weed control trial in soyabean at Samaru, 1984 to 1988 wet seasons

Treatments	
Spacing [1]	
45cm x 8.33cm	
60cm x 6.25cm	
75cm x 5.00cm	
90cm x 4.17cm	
Weed control [2]	
	Herbicide rate (kg a.i/ha)
Metolachlor + metobromuron (Galex)	0.75 + 0.75
Metolachlor + metobromuron	0.75 + 0.75 followed by SHW[3] at 6 WAS[4]
Metolachlor + metobromuron	1.5 + 1.5
Metolachlor + metobromuron	1.5 + 1.5 followed by SHW at 6 WAS
Hoe- weeded at 3 and 6 WAS (control)	
Weedy check	

1. Alloted to main plots
2. Alloted to sub plots
3. Supplementary hoe-weeding
4. Weeks after sowing.

3.4 Herbicide Application

Herbicide treatments were applied a day after sowing soyabean using a CP3 knapsack sprayer fitted with a green deflector nozzle and kept at a pressure of 2.1 kg/cm^2 to deliver 240 to 260 L/ha of the spray solution.

3.5 Crop Protection

Weeding operations were carried out using the West African hand hoe. In the weed interference trial, the appropriate plots were kept weed-free through fortnightly weedings while plots in the weed control trials were weeded at the time(s) indicated in the treatment. Leaf feeding beetles (Ootheca mutabilis) were controlled in 1984 and 1986 through a spray at 2 WAS of Cymbush 10 EC (Cypermethrin) at the rate of 0.01 kg a.i/ha by dissolving 50ml of the chemical in 10L of water and spraying using a CP3 Knapsack sprayer fitted with a red nozzle and a sprayer pressure of 2.1 kg/cm^2.

3.6. Observation and Data Collection

3.6.1 Weed infestation

3.6.1.1 Weed dry weight

Weed dry matter was obtained by taking weed samples from 1.0 m^2 quadrat in all plots at 6,9, and 12 WAS and at harvest. Before any plot was weeded, the weed samples were first taken before the operation. The weeds removed were oven dried at 70°C to a constant weight.

3.6.1.2 Cumulative weed dry weight

The weight of all the weed samples taken at the various sampling periods were added up to give the cumulative weed weight for each plot.

3.6.2 Crop growth Parameters

The crop growth parameters observed were stand count, vigour score, ground cover, plant height and number of branches per plant.

The number of stands per net plot were counted and recorded at 3 WAS and at harvest to assess the effect of treatments on crop establishment.

At 6,9, and 12 WAS the crop vigour score, ground cover, plant height and number of branches per plant were taken. Plant height and number of branches per plant were further taken at harvest.

The crop vigour score was assessed based on a zero-to-ten scale. Zero was assigned to plots with completely dead crop plants and ten to plots with most healthy crop plants (Table 7).

Table 7: Crop vigour score scale

Score	Crop condition
0	Competely killed
1	Moribund
2	Only few green tissue present
3	Definite growth reduction and severe toxicity symptoms and less likely to survive
4	Definite growth reduction and severe toxicity symptoms but apparently still making some growth.
5	Distinguishable inhibition of growth and other injury symptoms
6	Distinguishable inhibition of growth and slight discoloration and other injury symptoms
7	Distinguishable inhibition of growth.
8	Slight discoloration and low vigour, discoloration and necrotic spots.
9	Slight discoloration or lower vigour
10	Most healthy in the whole experiment.

The percent ground cover was determined using the method used by Adeleke (1984) in groundnut by measuring the diameter of the crop shoot spread using a tape measure. The figure obtained was expressed as a percentage of the inter-row spacing of the crop.

Height measurements of five randomly selected plants were taken from the base of each plant at ground level to the tip of the main shoot and the average height recorded.

The number of branches produced by five randomly selected plants was determined and the average number recorded.

3.6.3 Yield and yield components

At harvest, the yield and yield components assessed included number of pods produced per plant, number of grains per pod, grain yield per plot and 1000 - grain weight.

At harvest, the total number of pods from five randomly selected plants taken from the net plot were counted and the average number per plant recorded.

From the pods harvested above a sample of 20 pods was taken and threshed and the average number of grains per pod determined and recorded.

The crop in the net plot was harvested, threshed and weighed and the obtained weights recorded.

A sample of 1000 grains were counted from the yield of each plot and the weight determined and recorded.

3.6.5. Data analysis

All data were subjected to analysis of variance to test treatment effects for significance using "F" test as described by Snedecor and Cochran (1967). Significant differences between treatment means were compared using the Duncan Multiple Range Test (Duncan, 1955). Simple correlation coefficients were calculated from the mean of each parameter using the following equation as given by Snedecor and Cochran (1967):

$$r = \frac{Sp \times 4}{\sqrt{SS_x \times SS_Y}}$$

Where r = correlation coefficient between x and y

SP = Sum of product

SS = Sum of squares

X = Independent variable

Y = Dependent variable.

Regression analysis was also carred out to determine the association between the grain yield and cumulative weed dry weight. Curves of predicted values of soyabean grain yield as related to periods of weed interference were obtained using the quadratic equation.

$$Y = a + bx + Cx^2$$

where y = yield and X is the function of the time of weeding chosen such that the scope is zero at t = 0) (time of sowing) at X = 15 (time of final harvest) and b and c are regression coefficients. The direct and indirect contributions of the yield component to grain yield were partitioned (Path-coefficient analysis) using the method described by Dewey and Lu (1959). and the percentage contribution of each character was partitioned in accordance with Ajala et al. (1996).

CHAPTER 4

RESULTS

4.1 Effects of Intra-row spacing and Period of Weed Interference on the growth and yield of soyabean

The effects of row spacing and period of weed interference on weed dry matter production and various growth parameters viz stand count, crop vigour score, ground cover, plant height and yield and yield attributes of soyabean are presented in Tables 8 to 74

4.1.1 Weed dry weight

Weed dry weight (WDW) was significantly affected by row spacing in all the trials except at harvest in 1984 (Table 8 - 11). Row spacing at 45cm resulted in significantly lower weed dry weight than at 75 and 90cm.

The period of weed interference also had significant effect on WDW in all the trials except at 12 WAS in 1988. Plots infested for 3 WAS and those kept weed-free initially for 3 and 6 WAS produced significantly lower WDW than those infested until 6 WAS in all the trials. With the exception of 1985, weed weight of plots kept weed-free for 3 WAS only was significantly higher than those of the corresponding weed infested plots and those kept weed-free until 6 WAS. At 9 WAS, increase in weed-free period from 3 to 9 WAS resulted in a significant decrease in weed weight in all the trials. In addition, the plots weed-infested for 3 and 6 WAS produced weed weights comparable to those kept weed-free initially for

9 WAS but significantly lower than those infested until 9 WAS. At 12 WAS, the weed weight of the plots weed-infested for the same period was significantly higher than those of various weed interference periods in all the trials except in 1988. While weed weight decreased significantly with increasing weed-free period, weed infestation for 9 WAS resulted in lower weed weight than 3 WAS. Weed infestation for 9 WAS also resulted in weed weight comparable to that kept weed-free initially for 12 WAS.

At harvest, weed weight of the plots infested until harvest was significantly higher than those of all the other weed interference periods in all the trials except 1988. Weed weight decreased significantly with increasing weed-free period until 9 WAS in 1985, 1986 and 1988 and 12 WAS in 1984. Weed weight did not differ significantly among the plots weed infested initially for various periods until 9 WAS in 1984 and 1985 and 12 WAS in 1986 and 1988.

The interaction between row spacing and period of weed interference on WDW was significant at all stages of crop growth in all the trials (Tables 12 - 26) except at harvest in 1984. At 6 WAS weed infestation up to 6 weeks in rows spaced 90 cm apart resulted in the maximum WDW but was comparable to weed infestation for 6 WAS in rows spaced 75cm apart in 1984 and 1985. In 1984 when the crop

was kept weed-free initially for 3 weeks, crop spacing at 45cm resulted in WDW comparable to that of 60cm spacing but significantly lower than 75 and 90cm row spacing. However, when the weed-free period was further increased by 3 weeks 45cm row spacing only resulted in significantly lower WDW than 90cm. With infestation for the first 6 weeks, weed dry weight increased with spacing up to 75cm. In 1985, there were no significant differences in WDW among row spacings on the plots kept weed-free initially for 3 and 6 weeks and those weed-infested for 3 WAS, while in 75 and 90cm spacings resulted in higher weed weights than 45 and 60cm on the plots kept weed-infested for 6 WAS. In 1986 while (WDW) in plots kept weed-free for 3 WAS in 45, 60 and 75cm spacings was comparable but significantly lower than in 90cm row spacing no significant differences were observed among row spacings when the plots were kept weed-free initially for 6 WAS. In 1988 when the plots were kept weed-free initially for 3 WAS weed weights under 45cm crop spacing was significantly lower than at 90cm while no difference was observed among spacings when kept weed-free for a further 3 WAS. Weed weight increased with spacing in the plots weed-infested for 6 WAS while 75 and 90cm spacings caused higher values than 45 and 60cm with weed infestation for 3 WAS only. With initial weed infestation for 3 WAS 45 and 60cm spacing caused similar

weed weights that were significantly lower than at 90cm, while WDW at 75cm spacing was comparable to that produced at 90cm. However, with increase in period of weed infestation to 6 WAS each increase in row spacing caused a significant increase in WDW. Plots initially kept weed-free for 3 WAS and those weed-infested for 3 WAS produced similar WDW in 75cm row spacing.

At 9 WAS (Tables 16 - 19) WDW did not differ significantly among row spacings on the plots weed-infested for 3 and 6 WAS and kept weed-free for 9 WAS in 1984, 1985 and 1986 and on the plots kept weed-free initially for 3 and 6 WAS in 1985 and 1988, respectively. Row spacing of 90cm resulted in higher WDW than 45cm on the plots kept weed-free initially for 3 WAS in 1984 and 1988, weed-free for 6 WAS in 1986 and those weed-infested for 3 WAS only in 1988 WDW of the plots at 90cm spacing was higher than those of the other spacings on the plots weed-infested initially for 9 WAS in 1984 and 1988 and those kept weed-free for the same period in 1988. WDW however increased with spacing on the plots weed-free infested for 9 WAS while 90 and 75cm spacing caused higher WDW than 45cm on the plots infested for 9 WAS in 1985 and 1988.

At 12 WAS, row spacing had no significant effect on WDW on the plots weed-infested for 3,6 and 9WAS in 1985, 1986 and 1988 and those kept weed-free for 3 WAS to 12

WAS in 1986 and 1988. WDW at 90cm row spacing was significantly higher than those of the other spacings on the plots kept weed-free for 3 and 6 WAS in 1984 and 3 WAS in 1985. WDW at 75cm spacing was also higher than those of the lower spacings on the plots kept weed-free for 3 and 6 WAS in 1984. Row spacing of 90cm resulted in higher WDW than 45cm only on the plots weed-infested for 3 and 6 WAS in 1984 and those kept weed-free for 9 and 12 WAS in 1985. WDW however, increased with row spacing on the plots weed infested for 12 WAS in 1984 and 1985, while it increased up to 75cm for the same weed infestation period in 1986 and 1988.

At harvest in all years row spacing did not affect WDW significantly in the plots weed-infested for 3 WAS to 12 WAS, while it increased with spacing on the plots infested until harvest. Row spacing of 90cm resulted in higher WDW than the other narrower spacings on the plots kept weed-free initially for 12 WAS in 1986 and 1988 and 9 WAS in 1985. On the plots kept weed-free for 3 WAS in 1986, 75cm spacing also resulted in higher WDW than narrower spacings. WDW under row spacing of 90cm was significantly higher than under spacings of 45cm on the plots kept weed-free for 9 WAS in 1985 and 12 WAS in 1986 and higher than 45cm and 60cm on the plots kept weed-free for 6 and 9 WAS in 1985 and 9 WAS and until harvest in 1988.

Table 8: Effects of row spacing and period of Weed interference on Weed dry weight in soyabean at Samaru, 1984 wet season.

Treatments	Weed dry weight (t/ha) at 6 WAS[1/]	9 WAS	12 WAS	Harvest
Inter-row and Intra-row spacing (I)				
45cm x 8.33cm	0.6d[2/]	1.2c	1.2d	0.8
60cm x 6.25cm	1.0c	1.4b	1.3c	0.8
75cm x 5.00cm	1.2b	1.5b	1.6b	0.9
90cm x 4.17cm	1.4a	1.7a	1.9a	1.0
S.E ±	0.075	0.03	0.04	0.0
Period of weed interference (W)				
Weed free for 3 WAS	0.7b	1.1b	1.7b	1.6b
Weed free for 6 WAS	0.4c	0.6c	1.1c	0.9c
Weed free for 9 WAS	-	0.4d	0.4d	0.3d
Weed free for 12 WAS	-	-	0.3f	0.2d
Weed free until harvest	-	-	-	0.2d
Weed infested for 3 WAS	0.4c	0.4d	0.5d	0.3d
Weed infested for 6 WAS	2.0a	0.4d	0.4de	0.3d
Weed infested for 9 WAS	-	3.5a	0.3ef	0.2d
Weed infested for 12 WAS	-	-	5.1a	0.2d
Weed infested until harvest	-	-	-	4.5a
S.E ±	0.04	0.05	0.04	0.117
Interaction				
I x W	*[3/]	*	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ Significant at 5% level of probability

Table 9: Effects of row spacing and period of Weed interference on Weed dry weight in soyabean at Samaru, 1985 wet season

Treatments	Weed dry weight (t/ha) at 6 WAS[1/]	9 WAS	12 WAS	Harvest
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	0.74b	1.2c	1.2d	0.7c
60cm x 6.25cm	1.0b	1.3b	1.4c	1.0b
75cm x 5.00cm	1.3a	1.6a	1.7b	1.0b
90cm x 4.17cm	1.5a	1.6a	2.1a	1.3a
S.E ±	0.05	0.04	0.04	0.032
Perod of weed interference (W)				
Weed free for 3 WAS	0.6b	1.7b	1.9b	1.7b
Weed free for 6 WAS	0.4b	0.7c	1.2c	1.0c
Weed free for 9 WAS	-	0.3d	0.6d	0.4d
Weed freed for 12 WAS	-	-	0.4ef	0.3de
Weed free until harvest	-	-	-	0.3de
Weed infested for 3 WAS	0.4b	0.4d	0.4ef	0.4de
Weed infested for 6 WAS	2.0a	0.4d	0.5de	0.3de
Weed infested for 9 WAS	-	3.2a	0.4ef	0.3de
Weed infested for 12 WAS	-	-	-	0.2e
Weed infested until harvest	-	-	-	5.1a
S.E ±	0.09	0.05	0.05	0.048
Interaction				
I x W	*[3/]	*	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level probability using the Duncan's Multiple Range Test (DMRT)
3/ Significant at 5% level of probability

Table 10: Effects of row spacing and period of Weed interference on Weed dry weight in soyabean at Samaru, 1986 wet season

Treatments	Weed dry weight (t/ha) at 6 WAS[1]/	9 WAS	12 WAS	Harvest
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	0.8d[2]/	0.9d	1.2b	0.7c
60cm x 6.25cm	1.0c	1.1c	1.5b	0.8c
75cm x 5.00cm	1.4b	1.3b	1.8a	0.9b
90cm x 4.17cm	1.7a	1.5a	2.0a	1.1a
S.E ±	0.04	0.2	0.08	0.032
Period of weed interference (W)				
Weed free for 3 WAS	0.7b	1.7b	1.9b	1.8b
Weed free for 6 WAS	0.5c	0.7c	1.3c	1.1c
Weed free for 9 WAS	-	0.4d	0.8d	0.6d
Weed free for 12 WAS	-	-	0.5d	0.4ef
Weed free until harvest	-	-	-	0.3ef
Weed infested for 3 WAS	0.40c	0.43d	0.5d	0.4e
Weed infested for 6 WAS	2.15a	0.38d	0.4d	0.3ef
Weed infested for 9 WAS	-	2.53a	0.5d	0.3ef
Weed infested for 12 WAS	-	-	5.0a	0.2f
Weed infested until harvest	-	-	-	3.5a
S.E ±	0.04	0.04	0.15	0.043
Interaction				
I x W	*[3]/	*	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT)
3/ Significant at 5% level of probability

Table 11: Effects of row spacing and period of Weed interference on Weed dry weight in soyabean at Samaru, 1988 wet season.

Treatments	Weed dry weight (t/ha) at 6 WAS[1]	9 WAS	12 WAS	Harvest
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	1.0d[2]	1.2d	1.2d	0.8d
60cm x 6.25cm	1.0c	1.2c	1.6c	0.9c
75cm x 5.00cm	1.3b	1.3b	1.9b	1.2b
90cm x 4.17cm	1.6a	1.7a	2.3a	1.5a
S.E ±	0.02	0.02	0.07	0.029
Period of weed interference (W)				
Weed free for 3 WAS	0.6b	1.8b	2.05	1.8b
Weed free for 6 WAS	0.5c	1.0c	1.43	1.1c
Weed free for 9 WAS	-	0.4d	1.01	0.7d
Weed free for 12 WAS	-	-	0.65	0.5de
Weed free until harvest	-	-	-	0.4ef
Weed infested for 3 WAS	0.38d	0.4d	0.4	0.4ef
Weed infested for 6 WAS	2.05a	0.4d	0.5	0.4ef
Weed infested for 9 WAS	-	2.8a	0.4	0.3ef
Weed infested for 12 WAS	-	-	5.5	5.5
Weed infested until harvest	-	-	-	5.5a
S.E ±	0.04	0.04	0.16	0.044
Interaction				
I x W	*[3]	*	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ Significant at 5% level of probability

Table 12: Interaction of row spacing and period of Weed interference on Weed dry weight at 6 WAS in soyabean at Samaru, 1984 wet season.

Period of weed interference	Weed dry weight (t/ha) 6 WAS. Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	0.5ef2/	0.6de	0.8cd	0.8cd
Weed -free for 6 WAS	0.2g	0.3fg	0.4efg	0.5ef
Weed -free for 9 WAS	-	-	-	-
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.2g	0.3fg	0.4efg	0.5ef
Weed infested for 6 WAS	1.0c	1.9b	2.4a	2.6a
Weed infested for 9 WAS	-	-	-	-
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.09		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 13: Interaction of row spacing and period of Weed interference on Weed dry weight at 6 WAS in soyabean at Samaru, 1985 wet season.

Period of weed interference	Weed dry weight (t/ha) 6 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	0.4c2/	0.6c	0.6c	0.7c
Weed -free for 6 WAS	0.3c	0.4c	0.4c	0.6c
Weed -free for 9 WAS	-	-	-	-
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.4c	0.5c	0.4c	0.4c
Weed infested for 6 WAS	1.3b	1.6b	2.3a	2.6a
Weed infested for 9 WAS	-	-	-	-
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.19		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 14: Interaction of row spacing and period of Weed interference on Weed dry weight at 6 WAS in soyabean at Samaru, 1986 wet season.

Period of weed interference	Weed dry weight (t/ha) 6 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	0.6fg2/	0.6fg	0.8fg	0.9e
Weed -free for 6 WAS	0.4ghi	0.4ghi	0.5gh	0.6fg
Weed -free for 9 WAS	-	-	-	-
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.2i	0.3hi	0.5gh	0.6fg
Weed infested for 6 WAS	1.3d	1.8c	2.5b	3.0a
Weed infested for 9 WAS	-	-	-	-
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±	0.08			

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 15: Interaction of row spacing and period of Weed interference on Weed dry weight at 6 WAS in soyabean at Samaru, 1988 wet season.

Period of weed interference	Weed dry weight (t/ha) 6 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	0.5fg2/	0.5fg	0.7ef	0.8e
Weed -free for 6 WAS	0.4fg	0.5fg	0.4fg	0.6fg
Weed -free for 9 WAS	-	-	-	-
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.2i	0.3hi	0.4fg	0.6efg
Weed infested for 6 WAS	1.4d	1.7c	2.3b	2.8a
Weed infested for 9 WAS	-	-	-	-
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.07		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 16: Interaction of row spacing and period of Weed interference on weed dry weight at 9 WAS in soyabean at Samaru, 1984 wet season

Period of weed interference	Weed dry weight (t/ha) at Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	0.8efg2/	1.0def	1.1de	1.3d
Weed -free for 6 WAS	0.5ghij	0.6ghi	0.6ghi	0.7fgh
Weed -free for 9 WAS	0.2j	0.3ij	0.4hij	0.5ghij
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.2j	0.3ij	0.4hij	0.5ghij
Weed infested for 6 WAS	0.3ij	0.4hij	0.3ij	0.4hij
Weed infested for 9 WAS	3.0c	3.5b	3.6b	4.0a
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.11		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 17: Interaction of row spacing and period of Weed interference on Weed dry weight at 9 WAS in soyabean at Samaru, 1985 wet season.

	Weed dry weight (t/ha) 9 WAS			
	Row spacing (cm)			
Period of weed interference	45	60	75	90
Weed -free for 3 WAS1/	1.5d2/	1.6d	1.8d	1.8d
Weed -free for 6 WAS	0.4fg	0.5efg	0.8ef	0.9e
Weed -free for 9 WAS	0.1g	0.2g	0.5efg	0.4fg
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.3g	0.4fg	0.4fg	0.4fg
Weed infested for 6 WAS	0.4fg	0.3g	0.5efg	0.3g
Weed infested for 9 WAS	2.8c	3.0bc	3.3ab	3.6a
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.14		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 18: Interaction of spacing and period of Weed interference on Weed dry weight at 9 WAS in soyabean at Samaru, 1986 wet season.

Period of weed interference	Weed dry weight (t/ha) 9 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	1.4e1/	1.5e	1.8d	1.9d
Weed -free for 6 WAS	0.5g	0.7f	0.7f	0.8f
Weed -free for 9 WAS	0.3g	0.4g	0.3g	0.5g
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.4g	0.3g	0.5g	0.5g
Weed infested for 6 WAS	0.3g	0.4g	0.4g	0.4g
Weed infested for 9 WAS	1.9d	2.2c	2.8b	3.2a
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.07		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 19: Interaction of row spacing and period of weed interference on Weed dry weight at 9 WAS in soyabean at Samaru, 1988 wet season.

Period of weed interference	Weed dry weight (t/ha) 9 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	1.6e2/	1.8de	1.9d	2.0d
Weed -free for 6 WAS	0.9fg	0.8fgh	0.9fg	1.0f
Weed -free for 9 WAS	0.2l	0.3kl	0.3kl	0.7ghi
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.26l	0.4jkl	0.4gkl	0.5ijk
Weed infested for 6 WAS	0.3kl	0.3kl	0.5ijk	0.6hij
Weed infested for 9 WAS	2.5c	2.6bc	2.8b	3.2a
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.08		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 20: Interaction of row spacing and period of weed interference of weed dry weight at 12 WAS in soyabean at Samaru, 1984 wet season.

Period of weed interference	Weed dry weight (t/ha) 12 WAS Row spacing (cm 45	60	75	90
Weed -free for 3 WAS1/	1.5g2/	1.6g	1.8f	2.0e
Weed -free for 6 WAS	0.8i	0.9i	1.2h	1.5g
Weed -free for 9 WAS	0.3lm	0.3lm	0.5jk	0.6j
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.2m	0.3lm	0.3lm	0.4kl
Weed infested for 6 WAS	0.3lm	0.4kl	0.4kl	0.5jk
Weed infested for 9 WAS	0.3lm	0.4kl	0.5jk	0.6j
Weed infested for 12 WAS	4.2d	4.5c	5.4b	6.3a
Weed infested until harvest	-	-	-	-
S.E ±		0.07		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 21: Interaction of row spacing and period of weed interference on Weed dry weight at 12 WAS in soyabean at Samaru, 1985 wet season.

Period of weed interference	Weed dry weight (t/ha) 12 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	1.8f2/	1.8f	1.8f	2.1e
Weed -free for 6 WAS	0.8h	0.8h	1.4g	1.6fg
Weed -free for 9 WAS	0.4ij	0.6hij	0.7hi	0.8h
Weed -free for 12 WAS	0.1k	0.3jk	0.4ij	0.6hij
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.3jk	0.4ij	0.4ij	0.5hij
Weed infested for 6 WAS	0.4ij	0.5hij	0.5hij	0.6hij
Weed infested for 9 WAS	0.7hi	0.4ij	0.4ij	0.5hij
Weed infested for 12 WAS	3.8d	4.6c	5.7b	6.7a
Weed infested until harvest	-	-	-	-
S.E ±		0.10		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 22: Interaction of row spacing and period of weed interference on Weed dry weight at 12 WAS in soyabean at Samaru, 1986 wet season.

Period of weed interference	Weed dry weight (t/ha) 12 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	1.6defg2/	1.7def	2.0de	2.3d
Weed -free for 6 WAS	0.9fghi	1.0fghi	1.4efgh	1.7def
Weed -free for 9 WAS	0.5hi	0.7ghi	0.8fghi	1.1fghi
Weed -free for 12 WAS	0.2i	0.4	0.6hi	0.8fghi
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.4i	0.5hi	0.5hi	0.6hi
Weed infested for 6 WAS	0.2i	0.3i	0.4i	0.5hi
Weed infested for 9 WAS	0.4i	0.5hi	0.5hi	0.6hi
Weed infested for 12 WAS	3.9c	4.8b	5.9a	5.3ab
Weed infested until harvest	-	-	-	-
S.E ±		0.29		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 23: Interaction of row spacing and period of weed interference on Weed weight at 12 WAS in soyabean at Samaru, 1988 wet season.

Period of weed interferference	Weed dry weight (t/ha) 12 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	1.8def2/	1.8def	2.1de	2.5d
Weed -free for 6 WAS	0.9fghi	1.4efg	1.6defg	1.8def
Weed -free for 9 WAS	0.8ghi	0.8ghi	1.0fghi	1.6defg
Weed -free for 12 WAS	0.31i	0.5hi	0.ghi	1.0fghi
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	0.3i	0.4i	0.5hi	0.5hi
Weed infested for 6 WAS	0.4i	0.5hi	0.5hi	0.6hi
Weed infested for 9 WAS	0.3i	0.4i	0.5hi	0.5hi
Weed infested for 12 WAS	4.00c	5.0b	6.4a	6.8a
Weed infested until harvest	-	-	-	-
S.E ±		0.30		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 24: Interaction of row spacing and period of weed interference on weed dry weight at harvest in soyabean at Samaru, 1985 wet season

Period of weed interference	Weed dry weight (t/ha) Row spacings (cm) 45	60	75	90
Weed -free for 3 WAS1/	1.5fg2/	1.7f	1.6fg	2.0e
Weed -free for 6 WAS	0.4jkl	0.8i	1.2h	1.4gh
Weed -free for 9 WAS	0.2l	0.4jkl	0.4jkl	0.6ij
Weed -free for 12 WAS	0.2l	0.3kl	0.3kl	0.3kl
Weed -free until harvest	0.2l	0.2l	0.3kl	0.3kl
Weed infested for 3 WAS	0.3kl	0.4jkl	0.3kl	0.5jk
Weed infested for 6 WAS	0.2l	0.3kl	0.4jkl	0.4jkl
Weed infested for 9 WAS	0.2l	0.3kl	0.2l	0.4jkl
Weed infested for 12 WAS	0.2l	0.2l	0.2l	0.3kl
Weed infested until harvest	3.6d	4.8c	5.5b	6.6a
S.E		0.097		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 25: Interaction of row spacing and period of weed interference on weed dry weight at harvest in soyabean at Samaru, 1986 wet season.

Period of weed interference	Weed dry weight (t/ha) Row spacings (cm) 45	60	75	90
Weed -free for 3 WAS1/	1.5g2/	1.5g	1.8f	2.2e
Weed -free for 6 WAS	0.8h	0.9h	1.3g	1.5g
Weed -free for 9 WAS	0.3ij	0.5i	0.5i	1.0h
Weed -free for 12 WAS	0.2j	0.3ij	0.4ij	0.5i
Weed -free until harvest	0.2j	0.3ij	0.3ij	0.3ij
Weed infested for 3 WAS	0.3ij	0.4ij	0.4ij	0.5i
Weed infested for 6 WAS	0.2j	0.3ij	0.3ij	0.4ij
Weed infested for 9 WAS	0.2j	0.3ij	0.3ij	0.4ij
Weed infested for 12 WAS	0.2j	0.2j	0.2j	0.3ij
Weed infested until harvest	3.7d	4.4c	5.7b	6.3a
S.E ±		0.088		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 26: Interaction of row spacing and period of weed interference on weed dry weight at harvest in soyabean at Samaru, 1988 wet season.

Period of weed interference	Weed dry weight (t/ha) Row spacings (cm) 45	60	75	90
Weed -free for 3 WAS1/	1.6f2/	1.6f	1.9ef	2.2e
Weed -free for 6 WAS	0.7h.k	0.6i.l	1.4fg	1.6f
Weed -free for 9 WAS	0.4jkl	0.5jkl	0.8hij	1.1gh
Weed -free for 12 WAS	0.3kl	0.3kl	0.5jkl	1.0ghi
Weed -free until harvest	0.2l	0.2l	0.4jkl	0.8hij
Weed infested for 3 WAS	0.3kl	0.3kl	0.4jkl	0.4jkl
Weed infested for 6 WAS	0.3kl	0.4jkl	0.4jkl	0.4jkl
Weed infested for 9 WAS	0.2l	0.3kl	0.3kl	0.3kl
Weed infested for 12 WAS	0.2l	0.2l	0.2l	0.2l
Weed infested until harvest	4.1d	5.0c	6.1b	6.6a
S.E ±		0.152		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

4.1.2 Cumulative weed dry weight

In all the trials cumulative weed dry weight (CWDW) increased significantly with row spacing (Table 27)

Period of weed interference also significantly affected the CWDW in all the years. In all the trials plots kept weed-free initially for 12 WAS and those infested initially for 3 WAS in 1984, 1986 and 1988 and those kept weed-free for 9 WAS in addition to 1984 produced CWDW comparable to the least obtained with the plots kept weed-free throughout the crop life cycle. CWDW decreased significantly with initial weed-free period up to 9 WAS in 1984 and 1988 and up to 12 WAS in 1985 and 1986.

The interaction of spacing and period of weed interference was significant on CWDW in all the years (Table 28 - 31). In 1984, when plots were initially kept weed-free for 3 WAS, CWDW in rows of 60 and 75cm spacings were comparable but significantly higher and lower than that in 45 and 90cm row spacings, respectively. With a further 3 weeks weed-free period CWDW in crop at 60cm spacing was lower than that at 75cm and 90cm spacing; similar CWDW was obtained at 45 and 60cm row spacing in the weed interference treatment.

In the plots kept weed-free initially for 12 WAS and till harvest, CWDW in crop spaced at 45, 60 and 75cm apart was comparable but lower than that at 90cm spacing. On the plots infested initially for 3 weeks 90cm spacing resulted in higher

CWDW than 45cm spacing, while with infestation for 6 WAS the latter row spacing had lower value than all the other spacings. Up to 9 WAS and upto 90cm with 12 WAS initial weed infestation. With infestation throughout crop life cycle, only 45cm spacing had lower CWDW than the others. While at all the spacings CWDW increased with period of initial weed infestation, CWDW decreased with weed-free period upto 9 WAS at 45, 60 and 90cm spacings and upto 12 WAS at 75cm spacing.

In 1985, when initially kept weed-free for 3 weeks CWDW of crop at 45, 60 and 75cm row spacing was similar but lower than that at 90cm spacing. However, with 6 weeks initial weed-free period and infestation initially for 9 and 12 WAS and till harvest, increase in row spacing caused a significant increase in CWDW. CWDW at 45cm spacing was significantly lower than those of crops at 60, 75 and 90cm with weed-free period of 9 WAS and 75 and 90cm spacing in plots kept weed-free initially for 12WAS. The CWDW of crops at 45 and 60cm spacing were similar and significantly lower than those of the crops spaced at 75 and 90cm spacing in the plots kept weed-free thorughout. As observed in 1984, CWDW increased significantly with initial period of weed infestation at all spacings. With initial weed-free period, CWDW decreased up to 9 WAS at 45, 75 and 90cm spacing and up to 12 WAS at 60cm spacing. In 1986, CWDW for the plots kept weed-free initially for 3 and 6 weeks were similar for crop spaced at 45 and 60cm apart. However CWDW decreased with reuction in row spacing

from 90 to 60 cm on the plots kept weed-free initially for 3 WAS, spaced at 75 and 90cm resulted in higher CWDW than closer spacings in plots kept weed-free for 6 WAS. In plots initially kept weed-free for 9 and 12 weeks CWDW of crop at 45cm row spacing was comparable to that in 60cm spacing as was CWDW between 60 and 75cm spacings; CWDW in 45cm spacing was lower than that in 75cm spacing while that in 90cm spacing was higher than those of row spacings of 45 and 60cm. With a season-long weed-free period however, CWDW in crop at 45cm row spacing was comparable to that at 60 and 75cm row spacing but lower than that at 90cm row spacing; CWDW in 60, 75 and 90cm spacing was similar in the weed-free treatment. In plots initially kept weed infested for 3 weeks CWDW in 45, 60 and 75cm spacing was comparable; CWDW at 90cm was highest but comparable to 75cm spacing. When kept weed infested for a longer period up to 12 weeks CWDW increased with each increase in row spacing from 45cm row. With season-long weed infestation CWDW in 60 and 75cm row spacings were comparable but higher and lower than in 45 and 90cm row spacings, respectively. In 1988, with an initial weed-free period of 3 and 6 weeks CWDW in 45, 60 and 75cm row spacings were comparable. The CWDW in the 90cm row spacing however was higher and comparable to that in 75cm row spacing in plots initially kept weed-free for 3 and 6 weeks, respectively. With an initial weed-free period of 9 weeks CWDW in 45 and 60cm spacing was comparable but increased with further increase in

row spacing, however, with 12 weeks weed-free period and those kept weed-free throughout CWDW in 75cm row spacing was comparable to that in lower spacings. When plots were initially kept weed-infested for 3 weeks no significant differences in CWDW were observed among row spacings, however, with 6 and 9 weeks initial weed-free period CWDW in 45cm row spacing was lower than that in 90cm spacing. With 12 weeks weed-free period CWDW increased with increase in row spacing up to 75cm row spacing beyond which the increase was not significant, but with season-long weed infestation each increase in row spacing caused a significant increase in CWDW.

Table 27: Effects of row spacing and period of weed interference on cumulative weed dry weight of soyabean at Samaru, 1984 - 1988 wet seasons.

Treatments	Cumulative weed dry weight (t/ha) 1984	1985	1986	1988
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	3.8d[1/]	3.8d	3.1d	4.0d
60cm x 6.25cm	4.5c	4.6c	4.5c	4.8c
75cm x 5.00cm	5.3b	5.6b	5.5b	5.7b
90cm x 4.17cm	62.a	6.4a	6.0a	6.9a
S.E ±	0.064	0.070	0.083	0.085
Period of weed interference (W)				
Weed free for 3 WAS[3/]	4.9d	5.9c	6.2c	6.3c
Weed free for 6 WAS	3.0e	3.2d	3.5e	3.8e
Weed free for 9 WAS	1.5f	1.8e	2.2g	2.7f
Weed free for 12 WAS	1.3f	1.5f	1.7h	2.2fg
Weed free until harvest	1.3f	1.5f	1.7h	2.0gh
Weed infested for 3 WAS	1.3f	1.6f	1.7h	1.5h
Weed infested for 6 WAS	3.1e	3.2d	3.2f	3.4e
Weed infested for 9 WAS	6.2c	5.8d	5.5d	5.7d
Weed infested for 12 WAS	11.0b	10.8b	10.3b	10.6b
Weed infested until harvest	16.0a	15.9a	13.6a	15.6a
S.E ±	0.088	0.083	0.101	0.196
Interaction				
I x W	*[2/]	*	*	*

1/ Mean folled by the same letter(s) within the same column are not significantly different at 5% level of probability using the DMRT
2/ Significant at 5% level of probability
3/ Weeks after sowing.

Table 28: Interaction of row spacing and period of weed interference on cumulative weed dry weight in soyabean at Samaru, 1984 wet season

Period of weed interference	Cumulative weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	3.91[2/]	4.7k	5.2k	6.0j
Weed -free for 6 WAS	2.1n	2.4n	3.5lm	3.9l
Weed -free for 9 WAS	1.0r	1.2qr	1.7opq	2.0no
Weed -free for 12 WAS	1.0r	1.1r	1.1r	1.7opq
Weed -free until harvest	1.0r	1.1r	1.2qr	2.0no
Weed infested for 3 WAS	0.9r	1.2qr	1.4pqr	1.7opq
Weed infested for 6 WAS	1.9nop	3.0m	3.4lm	3.9l
Weed infested for 9 WAS	4.7k	5.9j	6.7i	7.5i
Weed infested for 12 WAS	8.8h	10.1g	11.8f	13.5d
Weed infested until harvest	12.9e	14.8a	16.9a	19.3a
S.E ±		0.179		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 29: Interaction of row spacing and period of weed interference on cumulative weed dry weight in soyabean at Samaru, 1985 wet season.

Period of weed interference	Cumulative weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	5.5j[2/]	5.7j	5.8j	6.6i
Weed -free for 6 WAS	1.9opq	2.5mn	3.8l	4.5k
Weed -free for 9 WAS	0.9tu	1.9opq	2.2m-p	2.2m-p
Weed -free for 12 WAS	0.8u	1.3r-u	1.7p-s	2.1nop
Weed free until harvest	0.8u	1.2stu	1.8o-r	2.2m-p
Weed infested for 3 WAS	1.3r-u	1.7p-s	1.4q-t	1.8o-r
Weed infested for 6 WAS	2.3mno	2.7m	3.7l	3.9l
Weed infested for 9 WAS	4.6k	5.4j	6.3i	7.1h
Weed infested for 12 WAS	8.3g	9.5f	11.6e	13.7d
Weed infested until harvest	11.9e	14.5c	17.2b	19.9a
S.E ±		0.173		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 30: Interaction of row spacing and period of weed interference on cumulative weed dry weight in soyabean at Samaru, 1986 wet season.

Period of weed interference	Cumulative weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	5.1hi[2/]	5.3h	6.4g	7.9e
Weed -free for 6 WAS	2.6nop	3.0mn	4.0kl	4.5ijk
Weed -free for 9 WAS	1.5s-v	2.1p-s	2.2opq	3.1mn
Weed -free for 12 WAS	1.0uv	1.6r-u	1.7q-t	2.3opq
Weed -free until harvest	0.9v	1.4tuv	1.5s-v	1.9q-t
Weed infested for 3 WAS	1.3tuv	1.5s-v	1.9q-t	2.2opq
Weed infested for 6 WAS	2.1p-s	2.8no	3.6lm	4.3jk
Weed infested for 9 WAS	4.0kl	4.7hij	6.2g	7.2f
Weed infested for 12 WAS	7.6ef	9.0d	10.9c	13.6b
Weed infested until harvest	11.1c	13.2b	13.0b	17.3a
S.E ±		0.210		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 31: Interaction of row spacing and period of weed interference on cumulative weed dry weight in soyabean at Samaru, 1988 wet season.

Period of weed interference	Cumulative weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	5.3jk[2/]	5.7ij	6.6ghi	7.5fg
Weed -free for 6 WAS	2.6n-r	3.3l-p	4.3kl	5.0jk
Weed -free for 9 WAS	1.8q.t	2.2p-t	2.6n-r	4.1klm
Weed -free for 12 WAS	1.5rst	1.8q-t	2.1p-t	3.7l-o
Weed -free until harvest	1.2st	1.5rst	2.0q-t	3.4l-o
Weed infested for 3 WAS	1.0t	1.4rst	1.7q-t	2.0q-t
Weed infested for 6 WAS	2.4o-s	2.9m-q	3.7lmn	4.4kl
Weed infested for 9 WAS	4.5kl	5.1jk	6.1hij	6.9gh
Weed infested for 12 WAS	8.4f	9.6e	12.0d	12.5d
Weed infested until harvest	11.6d	14.6c	16.3b	20.0a
S.E ±		0.382		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

4.2.3 Stand count

Period of weed interference had significant effect on stand count at 6 WAS in 1986 and at harvest in all the trials (Tables 32 - 35). In 1986, stand count on plots kept weed-free initially were higher than those plots infested initially, while weed-infestation for 6 WAS caused depression compared with 3 WAS. The 1985 weed infestation up to 9 WAS did not reduce soyabean stand count and was comparable to keeping the crop weed-free from 6 WAS up to harvest. Weed infestation up to 12 WAS and throughout crop life cycle resulted in the least soyabean stand count in all the trials. Similarly, the crop kept weed-free initially for 3 WAS only had lower stand count than the crop kept weed-free initially for 6WAS. In 1986 and 1988 keeping the crop weed -free until harvest resulted in significantly higher stand count than all all the other weed interference periods. In 1984 and 1985, plots kept weed-free for 3 WAS only and those infested for 12 WAS and until harvest caused significant depression of soyabean stand count at harvest compared with those kept weed-free throughout. In the two years, the plots kept weed-free for 3 WAS had higher stand count than those infested for 12 WAS and harvest. In 1986, the

other weed interference periods resulted in lower stand count at harvest than keeping the crop weed-free throughout, while weed infestation for 12 WAS and until harvest also depressed stand count than the other weed interference periods. The interaction between row spacing and period of weed interference on the stand count of soyabean was not significant.

Table 32: Effects of row spacing and period of weed interference on stand count of soyabean at Samaru, 1984 wet season.

Treatments	Stand count per $10m^2$ at 6 WAS1/	harvest
Inter-row and Intra-row spacings (I)		
45cm x 8.33cm	223.2	221.2
60cm x 6.25cm	223.1	221.5
75cm x 5.00cm	223.6	221.0
90cm x 4.17cm	223.2	221.4
S.E ±	0.24	0.54
Period of weed interference (W)		
Weed free for 3 WAS	224.3	220.2b3/
Weed free for 6 WAS	224.6	222.7a
Weed free for 9 WAS	-	220.9a
Weed free for 12 WAS	-	222.6a
Weed free until harvest	-	223.0a
Weed infested for 3 WAS	222.1	222.1a
Weed infested for 6 WAS	220.8	220.6a
Weed infested for 9 WAS	-	221.8a
Weed infested for 12 WAS	-	212.5c
Weed infested until harvest	-	211.8c
S.E ±	0.45	0.79
Interaction		
I x W	NS 2/	NS

1/ Weeks after sowing
2/ Not significant at 5% level of probability
3/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT

Table 33: Effects of row spacing and period of weed interference on stand count of soyabean at Samaru, 1985 wet season

Treatments	Stand count per $10m^2$ at 6 WAS1/	Harvest
Inter-row and Intra-row spacings (I)		
45cm x 8.33cm	224.6	222.3
60cm x 6.25cm	224.1	221.6
75cm x 5.00cm	223.7	219.9
90cm x 4.17cm	223.1	217.8
S.E ±	0.71	0.53
Period of weed interference (W)		
Weed free for 3 WAS	223.5	220.6b3/
Weed free for 6 WAS	223.8	222.3ab
Weed free for 9 WAS	-	221.1ab
Weed free for 12 WAS	-	222.2ab
Weed free until harvest	-	223.1a
Weed infested for 3 WAS	223.2	223.2a
Weed infested for 6 WAS	222.9	221.8ab
Weed infested for 9 WAS	-	221.9ab
Weed infested for 12 WAS	-	214.4c
Weed infested until harvest	-	212.4c
S.E ±	0.44	0.76
Interaction		
I x W	NS2/	NS

1/ Weeks after sowing
2/ Not significant at 5% level of probability
3/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT

Table 34: Effects of row spacing and period of Weed interference on stand count of soyabean at Samaru, 1986 wet season

Treatments	Stand count per $10m^2$ at 6 WAS1/	Harvest
Inter-row and Intra-row spacings (I)		
45cm x 8.33cm	224.2	221.4
60cm x 6.25cm	222.7	221.3
75cm x 5.00cm	224.2	221.5
90cm x 4.17cm	223.3	221.3
S.E ±	0.39	0.20
Period of weed interference (W)		
Weed free for 3 WAS	225.6a	221.9b3/
Weed free for 6 WAS	225.4a	222.3b
Weed free for 9 WAS	-	220.9b
Weed free for 12 WAS	-	222.6b
Weed free until harvest	-	226.1a
Weed infested for 3 WAS	223.5b	221.0b
Weed infested for 6 WAS	221.1c	221.0b
Weed infested for 9 WAS	-	220.8b
Weed infested for 12 WAS	-	212.8c
Weed infested until harvest	-	211.9c
S.E ±	0.65	0.73
Interaction		
I x W	NS2/	NS

1/ Weeks after sowing
2/ Not significant at 5% level of probability
3/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT

Table 35: Effects of row spacing and period of weed interference on stand count of soyabean at Samaru 1988 wet season

Treatments	Stand count per $10m^2$ at 6 WAS1/	Harvest
Inter-row and Intra-row spacings (I)		
45cm x 8.33cm	224.8	222.3
60cm x 6.25cm	224.6	222.6
75cm x 5.00cm	224.7	222.6
90cm x 4.17cm	224.7	222.4
S.E ±	0.41	0.35
Period of weed interference (W)		
Weed free for 3 WAS	224.8	221.3b3/
Weed free for 6 WAS	224.6	222.1b
Weed free for 9 WAS	-	222.6b
Weed free for 12 WAS	-	222.8b
Weed free until harvest	-	2226.0a
Weed infested for 3 WAS	224.9	221.9b
Weed infested for 6 WAS	224.5	221.6b
Weed infested for 9 WAS	-	223.6b
Weed infested for 12 WAS	-	212.7c
Weed infested until harvest	-	212.0c
S.E ±	0.46	0.68
Interaction		
I x W	NS2/	NS

1/ Weeks after sowing
2/ Not significant at 5% level of probability
3/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT

4.1.4 Crop vigour score

Crop vigour score of soyabean was significantly affected by inter-row spacing at 6WAS in, 1984 and 1986 6 and 9 WAS in 1985 and 6, 9 and 12 WAS in 1988 (Tables 36 to 39). In all cases soyabean spaced 45cm apart between rows had significantly higher vigour than those at 75 and 90cm row spacings. At 6 WAS in 1984 and 1985, 9 WAS in 1986 and throughout 1988, crop vigour scores of soyabean at 45 and 60cm row spacings were similar. At 9 WAS in 1985, crop vigour score decreased with increase in row spacing up to 75cm.

In all the trials, period of weed interference significantly affected crop vigour score. Plots kept weed-free initially for 3 WAS and those infested for 6 WAS had lower crop vigour score than appropriate maximum. Similarly, weed infestation for 6 and 9 WAS in all the years and those infested for 3 WAS in addition in 1985 and 1988 as well as those kept weed-free for 3 and 6 WAS in 1984 and 1985 and 3 WAS in 1986 and 1988 had lower crop vigour score at 9 WAS than that kept weed-free for the period of observation. With the exception of 1988, crop kept weed-free for 6 and 9 WAS and those infested for 3 and 6 WAS had vigour score at 12 WAS comparable to the maximum obtained with the crop kept weed-free until the time of the observation. Vigour score of the crop kept weed-free initially for 3 WAS only was comparable or

lower than that of the crop infested for 9 WAS except in 1988. Crop infested for 9 WAS did not differ significantly in vigour score from that infested until 12 WAS in 1984, 1985 and 1988.

Interaction of row spacings and periods of weed interference did not cause significant differences in crop vigour scores.

Table 36: Effects of row spacing and period of weed interference on crop vigour score of soyabean at Samaru, 1984 wet season.

Treatments	Crop vigour score at 6 WAS1/	9WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	8.8a2/	8.4	9.2
60cm x 6.25cm	8.6ab	8.3	9.1
75cm x 5.00cm	8.3bc	8.2	9.1
90cm x 4.17cm	8.1c	7.8	8.9
S.E ±	0.13	0.22	0.14
Period of weed interference (W)			
Weed free for 3 WAs	7.7b	7.1b	8.3c
Weed free for 6 WAS	9.2a	8.0b	9.7a
Weed free for 9 WAS	-	9.7a	9.8a
Weed free for 12 WAS	-	-	9.7a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	9.2a	9.1a	9.7a
Weed infested for 6 WAS	7.9b	7.2b	9.5ab
Weed infested for 9 WAS	-	7.1b	8.8bc
Weed infested for 12 WAS	-	-	8.2cd
Weed infested until harvest	-	-	-
S.E ±	0.20	0.35	0.28
Interaction			
I x W	NS 3/	NS	NS

1/ Weeks after sowing.
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3/ Significant at 5% level of Probability.

Table 37: Effects of row spacing and period of weed interference on crop vigour score of soyabean at Samaru, 1985 wet season.

Treatments	Crop vigour score at 6 WAS[1]/	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	8.3a[2]/	9.0a	9.2
60cm x 6.25cm	8.1ab	8.4b	9.0
75cm x 5.00cm	7.7bc	7.7c	9.0
90cm x 4.17cm	7.5c	7.4c	8.8
S.E ±	0.14	0.15	0.18
Period of weed interference (W)			
Weed free for 3 WAS	6.8b	7.44c	8.45c
Weed free for 6 WAS	8.9a	8.5b	9.5a
Weed free for 9 WAS	-	9.6a	9.5a
Weed free for 12 WAS	-	-	9.6a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	8.5a	8.31bc	9.7a
Weed infested for 6 WAS	7.03b	7.48bc	9.4a
Weed infested for 9 WAS	-	7.23c	8.53bc
Weed infested for 12 WAS	-	-	7.95c
Weed infested until harvest	-	-	-
S.E ±	0.19	0.37	0.25
Interaction			
I x W	NS[3]/	NS	NS

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3/ Not significant at 5% level of Probability

Table 38: Effects of row spacing and period of weed interference on crop vigour score of soyabean at Samaru, 1986 wet season

Treatments	Crop vigour score at 6 WAS1/	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	7.5	8.9a2/	9.4a
60cm x 6.25cm	7.2	8.7ab	8.9b
75cm x 5.00cm	7.0	8.3b	8.6bc
90cm x 4.17cm	6.6	7.7c	8.4c
S.E	0.20	0.15	0.12
Period of weed interference (W)			
Weed free for 3 WAS	6.2b	8.2b	7.6c
Weed free for 6 WAS	8.2a	9.2a	9.3a
Weed free for 9 WAS	-	9.7a	9.6a
Weed free for 12 WAS	-	-	9.5a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	8.2a	9.1a	9.6a
Weed infested for 6 WAS	5.9b	7.6bc	9.4a
Weed infested for 9 WAS	-	7.1c	8.6b
Weed infested for 12 WAS	-	-	7.8c
Weed infested until harvest	-	-	-
S.E ±	0.24	0.29	0.19
Interaction			
I x W	NS 3/	NS	NS

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3/ Not significant at 5% level of Probability

Table 39: Effects of row spacing and period of weed interference on crop vigour score of soyabean at Samaru, 1988 wet season

Treatments	Crop vigour score at 6 WAS1/	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	8.3a2/	8.9a	9.1a
60cm x 6.25cm	7.9ab	8.7ab	8.9ab
75cm x 5.00cm	7.6b	8.4b	8.6bc
90cm x 4.17cm	7.5b	8.0c	8.4c
S.E ±	0.13	0.11	0.12
Period of weed interference (W)			
Weed free for 3 WAS	7.4c	7.5c	8.4c
Weed free for 6 WAS	8.15b	9.3ab	9.3ab
Weed free for 9 WAS	-	9.9a	9.7a
Weed free for 12 WAS	-	-	9.6a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	8.8a	9.2b	9.7a
Weed infested for 6 WAS	7.4c	7.5c	9.1b
Weed infested for 9 WAS	-	7.3c	7.7d
Weed infested for 12 WAS	-	-	7.2d
Weed infested until harvest	-	-	-
S.E ±	0.20	0.20	0.18
Interaction			
I x W	NS 3/	NS	NS

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3/ Not significant at 5% level of Probability

4.1.5 Percent ground cover

As shown in Tables 40 to 43 row spacings significantly affected percent ground cover at all stages in all the trials. Each increase in inter-row spacing from 45 to 90cm resulted in a significant decrease in percent ground cover.

Percent ground cover was also significantly affected by period of weed interference. Weed infestation for 3 WAS resulted in higher percent ground cover than longer, except at 12 WAS in 1985 and 1986 when infestation for 3 and 6 WAS resulted in comparable ground cover. At 6 WAS, in all the trials except in 1984 when soyabean kept weed -free for 3 WAS resulted in comparable percent ground cover comparable to that kept weed-free for 6 WAS in all other trials, the crop kept weed -free for 6 WAS resulted in higher % ground cover than 3 WAS. At 9 WAS in all the trials soyabean kept weed -free till 9 WAS resulted in higher % ground cover than that kept weed -free for a shorter period. Also, except in 1986 when soyabean kept weed -free for 6 WAS resulted in significantly higher percent ground cover than 3 WAS, there were no significant differences in ground cover between 3 and 6 WAS. At 12 WAS, comparable percent ground cover were similar for all the soyabean crop kept weed-free for 3 WAS and more. Weed infestation for 3 WAS resulted in significantly higher percent ground cover than a longer

period of weed infestation. At 12 WAS in 1988 each increase in period of weed infestation from 3 WAS resulted in a significant decrease in percent ground cover.

Interaction of row spacing and period of weed interference was significant on soyabean ground cover at all stages of crop growth in all trials (Tables 44 to 55).

Soyabean ground cover at 6 WAS increased with decreasing row spacing up to 45cm in the plots kept weed-free for 3 WAS in 1988 and 3 and 6 WAS in 1986 and 6 WAS in 1985 as well as those weed-infested for 3 WAS in 1985, 1986 and 1988 and 6 WAS in 1988. Soyabean ground cover also improved significantly with decreasing spacing up to 60cm on the plots kept weed-free for 3 WAS in 1984 and 1985 and 6 WAS in 1984 and 1988 as well as those weed-infested for 3 WAS in 1984. On the plots kept weed-free for 6 WAS, spacing at 60 and 75cm resulted in ground cover significantly higher than those of 90cm spacing and lower than those of 45cm, while in all cases 90cm spacing caused lower soyabean ground cover than 45cm. Soyabean ground cover at 9 WAS increased with decreasing crop spacing up to 45cm on the plots weed-infested initially for 6 WAS in 1985, 1986 and 1988, and infested for 9 WAS in 1986 and 1988. The ground cover also increased with decreasing row spacing up to 60cm on the plot kept weed-

free intially for 3 and 6 WAS in 1984, 1985 and 1986, for 6 WAS in 1988, for 9 WAS in 1984, 1985 and 1988 as well as those weed-infested initially for 3 WAS in all the years. Row spacing of 90cm caused lower soyabean ground cover than all the other spacings on the plots kept weed-free initially for 9 and 3 WAS in 1986 and 1988, respectively. Row spacings at 60 at 75cm had similar ground cover which was also lower than that of 45cm on the plots weed-infested for 6 and 9 WAS in 1984 and 9 WAS in 1986. On these plots 90cm also had lower ground cover than the other narrower spacings.

In all the years, spacing did not significicantly affect the ground cover of soyabean in the plots kept weed-free initially for 3 WAS to 12 WAS. However, on plots weed-infested initially for 3 and 6 WAS, soyabean ground cover increased with decreasing spacing up to 6cm while it increased up to 45cm on the plots infested for 9 and 12 WAS.

Table 40: Effects of row spacing and period of weed interference on ground cover of soyabean at Samaru, 1984 wet season.

Treatments	Ground cover (%) at 6 WAS[1]/	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	94.5a[2]/	98.5a	99.6a
60cm x 6.25cm	90.1b	94.5b	98.2
75cm x 5.00cm	83.1c	90.3c	95.5c
90cm x 4.17cm	65.4d	78.7d	93.3d
S.E ±	0.75	0.20	0.06
Period of weed interference (W)			
Weed free for 3 WAS	88.2a	92.8c	100.0a
Weed free for 6 WAS	88.2a	92.9c	100.0a
Weed free for 9 WAS	-	95.8a	100.0a
Weed free for 12 WAS	-	-	100.0a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	87.7a	94.8b	98.7b
Weed infested for 6 WAS	79.2b	88.9d	92.8c
Weed infested for 9 WAS	-	84.7e	89.0d
Weed infested for 12 WAS	-	-	88.4d
Weed infested until harvest	-	-	-
S.E ±	0.96	0.30	0.15
Interaction			
I x W	*[3]/	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3/ Significant at 5% level of Probability

Table 41: Effects of row spacing and period of weed interference on ground cover of soyabean at Samaru, 1985 wet season.

Treatments	ground cover (%) at 6 WAS[1/]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	98.2a[2/]	98.2a	99.4a
60cm x 6.25cm	87.1b	95.1b	98.2b
75cm x 5.00cm	75.3c	90.4c	96.1c
90cm x 4.17cm	68.6d	81.6d	92.9d
S.E ±	0.18	0.27	0.10
Period of weed interference (W)			
Weed free for 3 WAS	88.4b	93.1c	100.0a
Weed free for 6 WAS	90.1a	94.0bc	100.0a
Weed free for 9 WAS	-	96.5a	100.0a
Weed free for 12 WAS	-	-	100.0a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	84.2c	94.8b	99.5a
Weed infested for 6 WAS	79.3d	91.2d	97.3b
Weed infested for 9 WAS	-	87.1e	93.5c
Weed infested for 12 WAS	-	-	89.3d
Weed infested until harvest	-	-	-
S.E ±	0.30	0.33	0.18
Interaction			
I x W	*[3/]	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3/ Significant at 5% level of Probability

Table 42: Effects of row spacing and period of weed interference on ground cover of soyabean at Samaru, 1986 wet season.

Treatments	Ground cover (%) at 6 WAS[1/]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	97.7a[2/]	98.7a	99.89a
60cm x 6.25cm	87.0b	95.3b	98.6b
75cm x 5.00cm	82.3c	90.1c	96.2c
90cm x 4.17cm	70.2d	77.2d	93.1d
S.E ±	0.23	0.10	0.09
Period of weed interference (W)			
Weed free for 3 WAS	88.6b	91.9c	100.0a
Weed free for 6 WAS	90.1a	93.8b	100.0a
Weed free for 9 WAS	-	96.9a	100.0a
Weed free for 12 WAS	-	-	100.0a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	83.4c	93.9b	97.6b
Weed infested for 6 WAS	78.1d	91.3c	97.7b
Weed infested for 9 WAS	-	84.9d	93.5c
Weed infested for 12 WAS	-	-	90.3d
Weed infested until harvest	-	-	-
S.E ±	0.28	0.26	0.19
Interaction			
I x W	*[3/]	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT
3/ Significant at 5% level of Probability

Table 43: Effects of row spacing and period of weed interference on ground cover of soyabean at Samaru, 1988 wet season

Treatments	Ground cover (%) at 6 WAS[1/]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	96.0a[2/]	98.7a	99.0a
60cm x 6.25cm	83.3b	95.0b	97.9b
75cm x 5.00cm	77.1c	89.1c	95.7c
90cm x 4.17cm	62.7d	81.1d	92.0d
S.E ±	0.25	0.15	0.09
Period of weed interference (W)			
Weed free for 3 WAS	85.3b	93.4bc	100.0a
Weed free for 6 WAS	88.7a	93.6b	100.0a
Weed free for 9 WAS	-	95.7a	100.0a
Weed free for 12 WAS	-	-	100.0a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	79.7c	94.0b	97.5b
Weed infested for 6 WAS	69.4d	92.9c	96.3c
Weed infested for 9 WAS	-	83.7d	90.7
Weed infested for 12 WAS	-	-	89.2e
Weed infested until harvest	-	-	-
S.E ±	0.30	0.21	0.19
Interaction			
I x W	* [3/]	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3/ Significant at 5% level of Probability

Table 44: Interaction of row spacing and period of weed interference on ground cover of soyabean at 6 WAS at Samaru, 1984 wet season

Period of weed interference	Ground cover (%) at 6 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	98.7a	86.7b	67.5e
Weed -free for 6 WAS	100.0a	97.6a	85.7bc	69.3e
Weed -free for 9 WAS	-	-	-	-
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	97.6a	95.8a	88.2b	69.2e
Weed infested for 6 WAS	89.5b	80.6cd	78.2d	68.4e
Weed infested for 9 WAS	-	-	-	-
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		1.97		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.

Table 45: Interaction of row spacing and weed interference period on ground cover of soyabean at 6 WAS at Samaru, 1985

Weed interference period	Ground cover (%) at 6 WAS Row spacings (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	99.5a	89.5f	71.3lm
Weed -free for 6 WAS	100.0a	93.4de	87.9fg	72.3l
Weed -free for 9 WAS	-	-	-	-
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	87.6g	81.6h	67.6n
Weed infested for 6 WAS	95.6c	78.6i	77.7ij	65.2o
Weed infested for 9 WAS	-	-	-	-
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.591		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 46: Interaction of row spacing and period of weed interference on ground cover of soyabean at 6 WAS at Samaru, 1986 wet season.

Period of weed interference	Ground cover (%) at 6 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	97.4b	87.4e	75.4h
Weed -free for 6 WAS	100.0a	95.7c	88.3e	70.4i
Weed -free for 9 WAS	-	-	-	-
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	82.6f	80.6g	70.4i
Weed infested for 6 WAS	93.2d	75.4h	75.6h	68.3j
Weed infested for 9 WAS	-	-	-	-
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.59		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.

Table 47: Interaction of row spacing and period of weed interference on ground cover of soyabean at 6 WAS at Samaru, 1988 wet season.

Period of weed interference	Ground cover (%) at 6 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	87.8c	84.2d	69.3g
Weed -free for 6 WAS	100.0a	99.6a	87.6c	67.6gh
Weed -free for 9 WAS	-	-	-	-
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	99.4a	73.6f	79.7e	66.3h
Weed infested for 6 WAS	89.7b	68.6g	63.9i	55.2j
Weed infested for 9 WAS	-	-	-	-
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.63		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 48: Interaction of row spacing and period of weed interference ofn ground cover of soyabean at 9 WAS at Samaru, 1984 wet season

Period of weed interference	Ground cover (%) at 9 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	100.0a	90.6de	80.1h
Weed -free for 6 WAS	100.0a	100.0a	91.6d	80.4h
Weed -free for 9 WAS	100.0a	100.0a	96.7b	86.6f
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	100.0a	95.0c	84.2q
Weed infested for 6 WAS	100.0a	89.4e	89.7e	76.6i
Weed infested for 9 WAS	96.7b	84.6g	84.5g	77.9j
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.60		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 49: Interaction of row spacing and weed interference period on ground cover of soyabean at 9 WAS at Samaru, 1985 wet season.

	Ground cover (%) at 9 WAS			
	Row spacing (cm)			
period of Weed interference	45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	100.0a	97.4b	88.5hij
Weed -free for 6 WAS	100.0a	100.0a	91.4efg	84.6mn
Weed -free for 9 WAS	100.0a	100.0a	90.4fgh	82.2o
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	100.0a	92.7def	86.6j.m
Weed infested for 6 WAS	100.0a	95.5c	89.8ghi	79.6p
Weed infested for 9 WAS	94.4cd	88.3ijk	86.3klm	79.5p
S.E ±		0.678		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 50: Interaction of row spacing and period of weed interference on ground cover of soyabean at 9 WAS at Samaru, 1986 wet season.

Period of weed interference	Ground cover (%) at 9 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	100.a	91.8d	75.5l
Weed -free for 6 WAS	100.0a	100.0a	92.7d	82.3j
Weed -free for 9 WAS	100.0a	100.0a	100.0a	87.4fg
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	100.0a	89.7e	85.7h
Weed infested for 6 WAS	100.0a	96.6b	88.4ef	80.0k
Weed infested for 9 WAS	94.8c	87.4fg	84.2i	73.3m
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.51		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 51: Interaction of row spacing and period of weed interference on ground cover of soyabean at 9 WAS at Samaru, 1988 wet season.

Period of weed interference	Ground cover (%) at 9 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	100.0a	100.0a	82.9h
Weed -free for 6 WAS	100.0a	100.0a	92.4d	81.9hi
Weed -free for 9 WAS	100.0a	100.0a	92.0d	81.6i
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	100.0a	89.6e	86.5f
Weed infested for 6 WAS	100.0a	98.4b	88.5e	84.7g
Weed infested for 9 WAS	95.3c	85.6fg	78.6j	75.3k
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.43		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 52: Interaction of row spacing and period of weed interference on ground cover of soyabean at 12 WAS at Samaru, 1984 wet season.

Period of weed interference	Ground cover (%) at 12 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	100.0a	100.0a	100.0a
Weed -free for 6 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free for 9 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free for 12 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	100.0a	98.0b	96.0d
Weed infested for 6 WAS	100.0a	100.0a	95.3e	94.3f
Weed infested for 9 WAS	100.0a	96.6c	89.9h	84.6j
Weed infested for 12 WAS	98.4b	92.6g	86.6i	78.4k
Weed infested until harvest	-	-	-	-
S.E ±		0.21		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 53: Interaction of row spacing and weed interference period on ground cover of soyabean at 12 WAS at Samaru, 1985 wet season.

Period of weed interference	Graund cover (%) at 12 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	100.0a	100.0a	100.0a
Weed -free for 6 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free for 9 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free for 12 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	100.0a	97.0b	92.4c
Weed infested for 6 WAS	100.0a	100.0a	96.6b	92.4c
Weed infersted for 9 WAS	100.0a	98.7b	91.4c	83.7f
Weed infested for 12 WAS	97.6b	91.6c	88.4d	79.5g
Weed infested until harvest	-	-	-	-
S.E ±		0.359		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 54: Interaction of row spacing and period of weed interference on ground cover of soyabean at 12 WAS at Samaru, 1986 wet season.

Period of weed interference	Ground cover (%) at 12 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	100.0a	100.0a	100.0a
Weed -free for 6 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free for 9 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free for 12 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	100.0a	98.8b	91.7e
Weed infested for 6 WAS	100.0a	100.0a	97.2c	93.6d
Weed infested for 9 WAS	100.0a	96.5c	92.0e	85.4g
Weed infested for 12 WAS	98.7b	93.6d	87.5f	80.3h
Weed infested until harvest	-	-	-	-
S.E ±		0.37		

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 55: Interaction of row spacing and period weed interference on ground cover of soyabean at 12 WAS at Samaru, 1988 wet season.

Period of weed interference	Ground cover (%) at 12 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS[1/]	100.0a[2/]	100.0a	100.0a	100.0a
Weed -free for 6 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free for 9 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free for 12 WAS	100.0a	100.0a	100.0a	100.0a
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	100.0a	100.0a	95.6b	90.7d
Weed infested for 6 WAS	100.0a	100.0a	95.7b	89.6e
Weed infested for 9 WAS	100.0a	94.2c	86.2g	82.3h
Weed infested for 12 WAS	95.7b	90.2de	87.4f	77.8i
Weed infested until harvest	-	-	-	-
S.E ±			0.37	

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatments are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

4.1.6 Plant height

Row spacing significantly influenced soyabean plant height at all stages in all the trials except at 12 WAS in 1988 (Tables 56 to 59). At all sampling stages in 1984, 1985 and 1986 and 9 WAS in 1988 plant height significantly decreased with increase in row spacing from 45 to 90cm. At 6 WAS in 1988, the height of soyabean at 60 and 75cm row spacing were similar. Period of weed interference had a significant effect on soyabean plant height at all stages of crop growth in all the trials with the exception of 12 WAS in 1988.

In all the years, keeping the plots weed infested for 6 WAS resulted in taller plants than for a shorter period. At 6 WAS, weed infestation initially for 6 WAS resulted in significantly taller soyabean plants than infestation for a shorter period and keeping the crop weed-free up to 6 WAS. In all the years, except in 1988 soyabean plant height in plots kept weed-free initially for 3 and 6 WAS did not differ in height. At 9 WAS, initial weed infestation for 9 WAS resulted in significantly taller plants than infestation for a shorter period or keeping the crop weed-free for 9 WAS. While in 1984, 1986 and 1988 increase in duration of

weed-free period resulted in reduction in plant height in 1985 however, soyabean kept weed-free initially for 6 and 9 WAS had similar height but significantly shorter than that kept weed-free initially for 3 WAS only. Soyabean kept weed-free initially for 9 WAS and that weed-infested initially for 3 WAS, had similar heights in 1986, and 1988, but in 1984 and 1985 the plots initially weed-infested had shorter plants. At 12 WAS soyabean in plots weed-infested initally for 12 WAS in 1984 and those kept weed-free initially for 3 WAS in 1985 and 1986 resulted in the tallest soyabean plants. In 1984, soyabean kept weed-free initially for 3 WAS and weed-infested for 9 WAS had comparable height to the maximum obtained, in 1985 only soyabean in plots kept weed-free for 3 WAS had comparable height to the maximum. While in 1986 plots weed infested initially for 9 and 12 WAS had comparable height to the maximum obtained. While in all the trials soyabean initially kept weed-free for 6 WAS and longer had similar height but significantly shorter than that kept weed-free for only 3 WAS, with increase in period of intial weed infestation plant height increased with it upto 9 WAS in 1984 and 6 WAS in 1986, while in 1985 the plant height increased with each increase in period of weed infestation.

Interaction of row spacing and period of weed interference on soyabean plant height at 6 WAS in 1984 (Table 60) and 9 WAS in 1986 (Table 61) was significant. Row spacing of 45cm resulted in taller soyabean plants than 90cm on the plot kept weed-free intially for 6 WAS and those infested for 3 and 6 WAS in 1984. In the trial, 45cm row spacing also had taller plants at 6 WAS than the other spacings on the plots kept weed-free for 6 WAS. In 1986, soyabean plants at 90cm spacing were significantly shorter at 9 WAS than all the other spacings on the plots kept weed-free for 3,6 and 9 WAS and those infested for 3 and 6 WAS only. Soyabean plant height however, reduced with increasing spacing up to 75cm on the plots weed-infested initially for 9 WAS, while it increased with reduction in spacing from 90cm to 60cm on the plots infested for 6 WAS. With an initial weed-free period of 6 weeks, however, soyabean in 45cm row spacing had comparable height only to that in 60cm spacing. On the plots kept weed-infested initially for 3 WAS soyabean plants at 45cm row spacing was also taller than those at

60 and 75cm spacings which had similar heights. While no difference in height was observed among the row spacings of 45, 60 and 75cm on the plots kept weed-free initially for 6 and 9 WAS, 45cm spacing had taller plants than 75cm on the plots kept weed-free for 3 WAS only.

Table 56: Effects of row spacing and period of weed interference on plant height of soyabean at Samaru, 1984 wet season.

Treatments	Plant height (cm) at 6 WAS	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	26.4a1/	60.2a	83.9a
60cm x 6.25cm	24.5b	56.9b	81.2b
75cm x 5.00cm	23.5c	55.0c	79.7c
90cm x 4.17cm	22.8d	52.9d	77.0d
S.E ±	0.14	0.26	0.65
Period of weed interference (W)			
Weed free for 3 WAS3/	22.1b	58.8c	84.9a
Weed free for 6 WAS	22.2b	54.3d	79.6b
Weed free for 9 WAS	-	50.9e	78.1b
Weed free for 12 WAS	-	-	77.6b
Weed free until harvest	-	-	-
Weed infested for 3 WAS	22.0c	49.5f	71.4c
Weed infested for 6 WAS	27.3a	60.1b	78.3b
Weed infested for 9 WAS	-	62.5a	83.3a
Weed infested for 12 WAS	-	-	87.7a
Weed infested until harvest	-	-	-
S.E ±	0.34	0.36	1.39
Interaction			
I x W	2/ *	NS4/	NS

1/ Means with the same letter(s) within a column and treatment are not significantly different at 5% level of probability using the DMRT.
2/ Significant at 5% level of probability.
3/ Weeks after sowing
4/ Not significantly different at 5% level of probability.

Table 57: Effects of row spacing and period of weed interference on plant height of soyabean at Samaru, 1985 wet season.

Treatments	Plant height (cm) at 6 WAS	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	27.8a1/	62.2a	85.1a
60cm x 6.25cm	25.2b	58.9b	82.6b
75cm x 5.00cm	24.4c	55.6c	79.4c
90cm x 4.17cm	23.4d	54.8d	77.4d
S.E ±	0.25	0.19	0.48
Period of weed interference (W)			
Weed free for 3 WAS2/	23.6b	60.5b	86.2a
Weed free for 6 WAS	22.9b	55.8d	80.4bc
Weed free for 9 WAS	-	55.0d	79.2c
Weed free for 12 WAS	-	-	78.0c
Weed free until harvest	-	-	-
Weed infested for 3 WAS	23.0b	51.3e	72.9d
Weed infested for 6 WAS	28.1a	59.3c	79.8c
Weed infested for 9 WAS	-	62.3a	82.6b
Weed infested for 12 WAS	-	-	87.6a
Weed infested until harvest	-	-	-
S.E ±	0.46	0.44	0.92
Interaction			
I x W	NS 3/	NS	NS

1/ Means with the same letter(s) within a column and treatment are not significantly different at 5% level of probability using the DMRT.
2/ Weeks after sowing
3/ Not significantly different at 5% level of probability.

Table 58: Effects of row spacing and period of weed interference on plant height of soyabean at Samaru, 1986 wet season.

Treatments	Plant height (cm) at 6 WAS	9WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	26.8a1/	63.8a	84.8
60cm x 6.25cm	25.1b	60.9b	82.0b
75cm x 5.00cm	24.1c	58.1c	78.5c
90cm x 4.17cm	23.3d	53.7d	75.9d
S.E ±	0.18	0.27	0.62
Period of weed interference (W)			
Weed free for 3 WAS3/	24.3b	62.0a	87.3a
Weed free for 6 WAS	23.7b	58.3b	79.9cd
Weed free for 9 WAS	-	56.2c	78.4cde
Weed free for 12 WAS	-	-	77.0de
Weed free until harvest	-	-	-
Weed infested for 3 WAS	21.7c	55.8c	69.8f
Weed infested for 6 WAS	26.6a	58.9b	81.7bc
Weed infested for 9 WAS	-	62.4a	83.4ab
Weed infested for 12 WAS	-	-	84.8ab
Weed infested until harvest	-	-	-
S.E ±	0.35	0.45	1.06
Interaction			
I x W	NS 4/	* 2/	NS

1/ Means with the same letter(s) within a column and treatment are not significantly different at 5% level of probability using the DMRT.
2/ Significant at 5% level of probability.
3/ Weeks after sowing
4/ Not significantly different at 5% level of probability.

Table 59: Effects of row spacing and period of weed interference on plant height of soyabean at Samaru, 1988 wet season.

Treatments	Plant height (cm) at 6 WAS	9 WAS	12 WAS
Inter and Intra-row spacings (I)			
45cm x 8.33cm	26.9a1/	61.7b	85.1
60cm x 6.25cm	24.0b	57.1b	83.1
75cm x 5.00cm	23.2bc	55.0c	82.0
90cm x 4.17cm	22.7c	51.9d	80.0
S.E ±	0.29	0.66	3.11
Period of weed interference (W)			
Weed free for 3 WAS2/	23.5b	58.8c	86.8
Weed free for 6 WAS	22.6c	53.3d	79.3
Weed free for 9 WAS	-	51.3e	77.9
Weed free for 12 WAS	-	-	89.9
Weed free until harvest	-	-	-
Weed infested for 3 WAS	22.0c	49.8e	73.8
Weed infested for 6 WAS	26.7a	61.1b	80.7
Weed infested for 9 WAS	-	63.4a	77.9
Weed infested for 12 WAS	-	-	88.7
Weed infested until harvest	-	-	-
S.E ±	0.41	0.71	5.84
Interaction			
I x W	NS 3/	NS	NS

1/ Means with the same letter(s) within a column and treatment are not significantly different at 5% level of probability using the DMRT.
2/ Weeks after sowing
3/ Not significantly different at 5% level of probability.

Table 60: Interaction of row spacing and period of weed interference on plant height of soyabean at 6 WAS at Samaru, 1984 wet season.

Period of weed interference	Plant height (cm) at 6 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	23.6c2/	22.3cdef	22.3cdef	20.3f
Weed -free for 6 WAS	25.9b	21.3ef	21.0ef	20.6ef
Weed -free for 9 WAS	-	-	-	-
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	23.4cd	22.6cde	21.4def	20.6ef
Weed infested for 6 WAS	28.7a	27.8ab	26.8ab	25.9b
Weed infested for 9 WAS	-	-	-	-
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.66		

1/ Weeks after sowing
2/ Means with the same letter(s) within a column and treatment are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

Table 61: Interaction of row spacing and period of weed interference on plant height of soyabean at 9 WAS at Samaru, 1986 wet season.

Period of weed interference	Plant height (cm) 9 WAS Row spacing (cm) 45	60	75	90
Weed -free for 3 WAS1/	65.4b2/	64.4bc	61.7cde	56.6hi
Weed -free for 6 WAS	60.3efg	61.2def	58.8fgh	52.7jk
Weed -free for 9 WAS	59.2efgh	56.8hi	57.7gh	50.9k
Weed -free for 12 WAS	-	-	-	-
Weed -free until harvest	-	-	-	-
Weed infested for 3 WAS	61.2def	56.6hi	54.6ij	50.6k
Weed infested for 6 WAS	63.6bcd	63.1bcd	56.7hi	52.2jk
Weed infested for 9 WAS	69.6a	64.2bc	58.6fgh	57.1hi
Weed infested for 12 WAS	-	-	-	-
Weed infested until harvest	-	-	-	-
S.E ±		0.89		

1/ Weeks after sowing
2/ Means with the same letter(s) within a column and treatment are not significantly different at 5% level of probability using the DMRT.
3. Row spacings: 45cm x 8.33cm, 60cm x 6.25cm, 75cm x 5.00cm and 90cm x 4.17cm

4.1.7 **Number of branches per plant**

The number of branches of soyabean was significantly affected by period at all stages of obervations in all the trials. (Tables 62-65) However, the interaction between row spacing and period of weed interference on number of branches per plant was not significant.

Except at 6 WAS in 1986 and 9 WAS in 1985 and 1988 weed infestation for 6 WAS and more resulted in fewer number of branches than infestation for 3 WAS Conversely, plants kept weed-free initially for 3 WAS only produced fewer number of branches than those kept weed-free for 6 WAS and more. In all the trials, plots kept weed-free initally for 3 WAS produced comparable number of branches to those in plots weed-infested for 6 WAS and more. In 1986 no difference in number of branches per plant of soyabean was observed between plants kept weed -free for 3 and 6 WAS while in 1988 weed infestation for 9 WAS caused lower number of branches than weedinfestation for 3 WAS. In 1985, plants in plots kept weed-free for 9 WAS produced more branches at 9 WAS than those kept weed - free for 3 WAS. In 1986, weed infestation for 9 and 12 WAS also resulted in significantly fewer branches at 12 WAS than infestation for 6 WAS only.

Table 62: Effects of row spacing and period of weed interference on number of branches per plant of soyabean at Samaru, 1984 wet season.

Treatments	Number of branches per plant 6 WAS	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	6.1	7.2	7.9
60cm x 6.25cm	6.0	7.1	7.8
75cm x 5.00cm	8.0	7.0	7.7
90cm x 4.17cm	5.7	7.8	7.7
S.E ±	0.15	0.21	0.25
Period of weed interference (W)			
Weed free for 3 WAS2/	5.5b3/	6.3b	9.6b
Weed free for 6 WAS	6.9a	7.4a	8.3a
Weed free for 9 WAS	-	7.7a	8.7a
Weed free for 12 WAS	-	-	9.0a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	6.4a	7.6a	8.4a
Weed infested for 6 WAS	5.0b	6.7b	7.2b
Weed infested for 9 WAS	-	6.4b	6.9b
Weed infested for 12 WAS	-	-	6.5b
Weed infested until harvest	-	-	-
S.E ±	0.26	0.26	0.32
Interaction			
I x W	NS 1/	NS	NS

1/ Not significant
2/ Weeks after sowing
3/ Means followed by the same letter(s) in a column and treatment are not significantly different at 5% level of probability using the DMRT.

Table 63: Effects of row spacing and period of weed interference on number of branches per plant of soyabean at Samaru, 1985 wet season

Treatments	Number of branches per plant at 6 WAS	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	6.1	7.3	7.8
60cm x 6.25cm	6.1	7.1	7.6
75cm x 5.00cm	5.9	7.0	8.0
90cm x 4.17cm	5.9	7.0	8.1
S.E ±	0.17	0.13	0.13
Period of weed interference (W)			
Weed free for 3 WAS2/	5.4b3/	6.8bc	7.2b
Weed free for 6 WAS	6.6a	7.6ab	8.6a
Weed free for 9 WAS	-	7.8a	9.3a
Weed free for 12 WAS	-	-	9.3a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	6.39	7.6ab	8.7a
Weed infested for 6 WAS	5.5b	6.6c	7.1b
Weed infested for 9 WAS	-	6.3c	6.6b
Weed infested for 12 WAS	-	-	6.4b
Weed infested until harvest	-	-	-
S.E ±	0.24	0.30	0.30
Interaction			
I x W	NS 1/	NS	NS

1/ Not significant
2/ Weeks after sowing
3/ Means followed by the same letter(s) in a column and treatment are not significantly different at 5% level of probability using the DMRT.

Table 64: Effects of row spacing and period of weed interference on number of branches per plant of soyabean at Samaru, 1986 wet season.

Treatments	Number of branches per plant at 6 WAS	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	6.1	7.3	7.9
60cm x 6.25cm	5.9	7.2	7.9
75cm x 5.00cm	5.8	7.1	7.8
90cm x 4.17cm	5.7	7.0	7.8
S.E ±	0.21	0.10	0.15
Period of weed interference (W)			
Weed free for 3 WAS2/	5.6b3/	6.5b	7.4b
Weed free for 6 WAS	5.9b	7.9a	8.4a
Weed free for 9 WAS	-	8.1a	8.9a
Weed free for 12 WAS	-	-	9.1a
Weed free until harvest	-	-	-
Weed infested for 3 WAS	6.5a	7.4a	4.8a
Weed infested for 6 WAS	4.8c	6.4b	7.2b
Weed infested for 9 WAS	-	6.3b	6.7c
Weed infested for 12 WAS	-	-	6.5c
Weed infested until harvest	-	-	-
S.E	0.25	0.32	0.25
Interaction			
I x W	NS 1/	NS	NS

1/ Not significant
2/ Weeks after sowing
3/ Means followed by the same letter(s) in a column and treatment are not significantly different at 5% level of probability using the DMRT.

Table 65: Effects of row spacing and period of weed interference on number of branches per plant soyabean at Samaru, 1988 wet season.

Treatments	Number of branches per plant at 6 WAS	9WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	**6.4**	7.3	7.8
60cm x 6.25cm	**6.2**	7.1	7.5
75cm x 5.00cm	**6.3**	7.1	8.0
90cm x 4.17cm	**6.4**	6.9	7.7
S.E ±	0.10	0.15	0.22
Period of weed interference (W)			
Weed free for 3 WAS2/	5.1b3/	6.6c	7.2
Weed free for 6 WAS	7.0a	7.8a	8.4a
Weed free for 9 WAS	-	7.9a	8.9a
Weed free for 12 WAS	-	-	**9.1**
Weed free until harvest	-	-	-
Weed infested for 3 WAS	6.7a	7.4ab	8.3a
Weed infested for 6 WAS	5.1b	6.4bc	7.1b
Weed infested for 9 WAS	-	6.3c	6.8b
Weed infested for 12 WAS	-	-	6.3b
Weed infested until harvest	-	-	-
S.E ±	0.31	0.32	0.35
Interaction			
I x W	1/ NS	NS	NS

1/ Not significant
2/ Weeks after sowing
3/ Means followed by the same letter(s) in a column and treatment are not significantly different at 5% level of probability using the DMRT.

4.1.9 Number of pods per plant

Period of weed interference significantly influenced number of pods per plant of soyabean in all the trials (Table 66). Maximum pod number was produced by the crop kept weed - free throughout the life cycle. In all the trials, plots kept weed-free to 12 WAS and those weed-infested only for 3 WAS produced comparable pod number to the maximum obtained from soyabean kept weed-free till harvest. In 1988, however, soyabean kept weed -free for 6 and 9 WAS also resulted in pod number comparable to the maximum obtained from plots kept weed-free till harvest. Weed infestation for 6 WAS resulted in significantly higher number of pods per plant of soyabean than soyabean kept weed-free for only 3 WAS. Pod number increased as the weed-free period was increased from 3 WAS to 9 WAS in 1984 and decreased with increase in weed infestation from 3 WAS to 9 WAS in 1984 and 1985 and 12 WAS in 1986. In 1988, pod number on the plots kept infested throughtout was significantly lower than those of all the other weed interference periods. The highest gain per week in soyabean pod number per plant of 6.5, 5.2, 4.8 and 7.7 in 1984,1985 1986 and 1988, respectively, was obtained when the crop was kept weed-free for a further 3 weeks beyond the first 3 WAS. Conversely, the highest loss per week in pod number per plant of 23.1, 17.6 and 15.8 in 1984, 1985, and 1988 respectively, was obtained when the crop was kept weed infested for a further 3 weeks beyond the first 3 WAS.

Interaction between row spacing and period of weed interference was not significant on number of pods per plant of soyabean.

Table 66: Effects of row spacing and period of weed interference on number of pods per plant of soyabean at harvest at Samaru, 1984 - 1988 wet seasons.

Treatments	Number of pods per plant 1984	1985	1986	1988
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	63.3	62.2	65.8	63.6
60cm x 6.25cm	63.8	64.0	63.6	61.4
75cm x 5.00cm	62.9	63.7	64.9	63.1
90cm x 4.17cm	61.3	62.0	64.6	62.4
S.E ±	0.87	0.67	1.05	1.11
Period of weed interference (W)				
Weed free for 3 WAS2/	53.4e3/	59.8e	58.3e	49.7bc
Weed free for 6 WAS	72.8c	75.3c	72.6c	72.7a
Weed free for 9 WAS	76.9b	79.2c	75.3bc	74.4a
Weed free for 12 WAS	81.8a	81.1ab	77.5ab	76.8a
Weed free until harvest	85.3a	84.3a	79.7a	79.5a
Weed infested for 3 WAS	84.4a	82.5a	77.5ab	71.4a
Weed infested for 6 WAS	61.3d	64.9d	66.1d	55.6b
Weed infested for 9 WAS	43.6f	51.3f	48.3f	42.7c
Weed infested for 12 WAS	42.5f	46.9f	44.4g	42.1c
Weed infested until harvest	41.4f	39.6g	41.1g	33.8d
S.E ±	1.27	1.69	1.29	2.64
Interaction				
I x W	1/ NS	**NS**	NS	**NS**

1/ Not significant
2/ Weeks after sowing
3/ Means followed by the same letter(s) in a column and treatment are not significantly different at 5% level of probability using the DMRT.

4.1.10 **1000-grain weight**

Period of weed interference significantly influenced 1000-grain weight in all the trials (Table 67). Keeping the plots weed-free till harvest resulted in the maximum grain weights in all trials. The plot kept weed-free for 9 and 12 WAS in 1984, 1985 and 1988 and 3 WAS and longer in 1986 produced 1000-grain weight comparable to the maximum obtained in the trials. Similarly, soyabean kept weed infested for 3 WAS only in 1984, 1985 and 1986 also produced 1000-grain weight comparable to the appropriate maximum obtained in each trial Weed-infestation until harvest resulted in significantly lower grain weight than infestation until 6 WAS in 1984. In all the years except in 1986, infestation up to 6 WAS and longer resulted in lower grain weight than weed infestation for 3 WAS.

Similarly, in all the years with the exception of 1986, crop kept weed-free initially for 3 WAS produced lower grain weights than the longer weed-free period but significantly higher than those infested for 9 WAS and more.

The interaction of row spacing and period of weed interference on 1000 - grain weight of soyabean was not significant in all the trials.

Table 67: Effects of row spacing and period of weed interference on 1000 - grain weight of soyabean at Samaru, 1984 - 1988 wet seasons

Treatments	1000-grain weight (g) 1984	1985	1986	1988
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	124.6	124.8	124.1	123.7
60cm x 6.25cm	124.2	124.6	120.4	124.0
75cm x 5.00cm	124.4	123.7	122.9	122.7
90cm x 4.17cm	124.3	122.0	122.9	121.5
S.E ±	0.48	0.68	1.55	0.61
Period of weed interference (W)				
Weed free for 3 WAS2/	122.9c3/	123.8b	123.4abc	124.6bc
Weed free for 6 WAS	126.2b	128.2a	126.7ab	126.4ab
Weed free for 9 WAS	127.0ab	128.4a	127.1a	127.4ab
Weed free for 12 WAS	128.0ab	129.1a	127.7a	127.7ab
Weed free until harvest	128.3a	129.0a	127.8a	127.9a
Weed infested for 3 WAS	127.0ab	127.9a	125.7a	123.0cd
Weed infested for 6 WAS	121.1d	121.0c	121.4abc	119.0ef
Weed infested for 9 WAS	118.6e	117.3c	119.1bc	120.6de
Weed infested for 12 WAS	118.8e	116.1d	110.2d	116.83f
Weed infested until harvest	117.1e	119.1c	116.6cd	116.1f
S.E ±	0.63	0.73	2.46	1.03
Interaction				
I x W	NS1/	NS	NS	NS

1/ Not significant
2/ Weeks after sowing
3/ Means followed by the same letter(s) in a column and treatment are not significantly different at 5% level of probability using the DMRT.

4.1.11 Grain yield

Significant differences in grain yield were observed among periods of weed interference in all the years (Table 68). Maximum soyabean grain yield of 2147, 1963, 2016 and 1921 kg/ha in 1984, 1985, 1986 and 1988 respectively, were obtained when the crop was kept weed-free throughout the crop growth period. The crop weed-infested for 3 WAS and those kept weed-free for 9 and 12 WAS also produced grain yields comparable to the maximum in all the years. The crops kept weed-free for 6 WAS only in 1985, 1986 and 1988 and those weed-infested for 6 WAS in 1986 also produced grain yields comparable to the maximum. The plot kept weed-free initially for 3 WAS produced lower grain yields than those kept weed-free for longer periods and those infested for 9 WAS and more in 1984 and until harvest in 1986. The highest gain in soyabean grain yield per week of 163.7, 331.0, 217.7 and 213kg/ha in 1984, 1985, 1986 and 1988 respectively, were obtained when the crop was kept weed-free for a further 3 weeks beyond the first 3 WAS. On the other hand, the highest reduction in grain yield per week of 334.3, 312.3 and 286kg.ha in 1984, 1985 and 1988, respectively, were obtained when the crop was kept weed-infested for a further 3 weeks beyond the first 3 WAS. In 1986, the highest yield reduction of 289.3kg/week was obtained when crop was kept weed-infested for a further 3 weeks after intial infestation for 6 WAS. In all the years, keeping the crop weed - free beyond the 6 WAS did not significantly

increase grain yield. Similarly, except in 1986, weed infestation initially for 6 WAS and beyond significantly reduced soyabean grain yield relative to when the crop was kept weed - infested only for 3 WAS. Also, except in 1986 after keeping the crop weed -infested for 9 WAS subsequent weeding did not significantly improve yields.

Table 68: Effects of row spacing and period of weed interference on grain yield of soyabean at Samaru, 1984 - 1988 wet season.

Treatments	Grain yield (kg/ha) 1984	1985	1986	1988
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	1450	1409	1463	1397
60cm x 6.25cm	1449	1406	1461	1392
75cm x 5.00cm	1447	1394	1436	1386
90cm x 4.17cm	1446	1396	1444	1392
S.E ±	238.7	54.1	92.6	82.3
Period of weed interference (W)				
Weed free for 3 WAS2/	1199c3/	788b	1152b	1073b
Weed free for 6 WAS	1690b	1781a	1808a	1712a
Weed free for 9 WAS	1848ab	1865a	1918a	1767a
Weed free for 12 WAS	1960ab	1909a	1980a	1868a
Weed free until harvest	2147a	1963a	2016a	1921a
Weed infested for 3 WAS	2143a	1950a	1980a	1902a
Weed infested for 6 WAS	1140c	1013b	1813a	1044b
Weed infested for 9 WAS	804d	835b	945b	890b
Weed infested for 12 WAS	745d	814b	853bc	931b
Weed infested until harvest	729d	775b	715c	757b
S.E ±	160.7	128.9	150.4	164.9
Interaction				
I x W	1/ NS	NS	NS	NS

1/ Not significant
2/ Weeks after sowing
3/ Means followed by the same letter(s) in a column and treatment are not significantly different at 5% level of probability using the DMRT.

Figures 1 to 4 show curves of predicted values of soyabean grain yield as affected by period of weed interference. In 1984, keeping soyabean initially weed - infested for 14,21 and 40 days after sowing (DAS) resulted in 20,30 and 50% reduction in potential yield of soyabean (Figure 1). On the other hand reductions in potential yields of 20, 30 and 50% occurred when soyabean was initially kept weed-free for 100, 56 and 28 days after sowing. In 1985 (Fig.2) 30 and 50 % reductions in soyabean potential yield were observed when the crop was initially kept weed infested for 18 and 35 DASand initially weed - free for 56 and 35 DAs, respectively.

Reductions in potential soyabean grain yield of 20,30 and 50% were obtained in plots initially kept weed infested for 14,21 and 35 DAS in 1986 (Fig. 3) and 14, 23 and 42 DAS in 1988 (Fig. 4) respectively. On the other hand keeping the plots weed-free initially for 20, and 39 DAS resulted in 30 and 50% reduction potential soyabean grain yield in 1986 while in 1988, reductions in potential yield of 20,30 and 50% were obtained when crop was intially kept weed-free for 70, 49 and 25 DAS respectively.

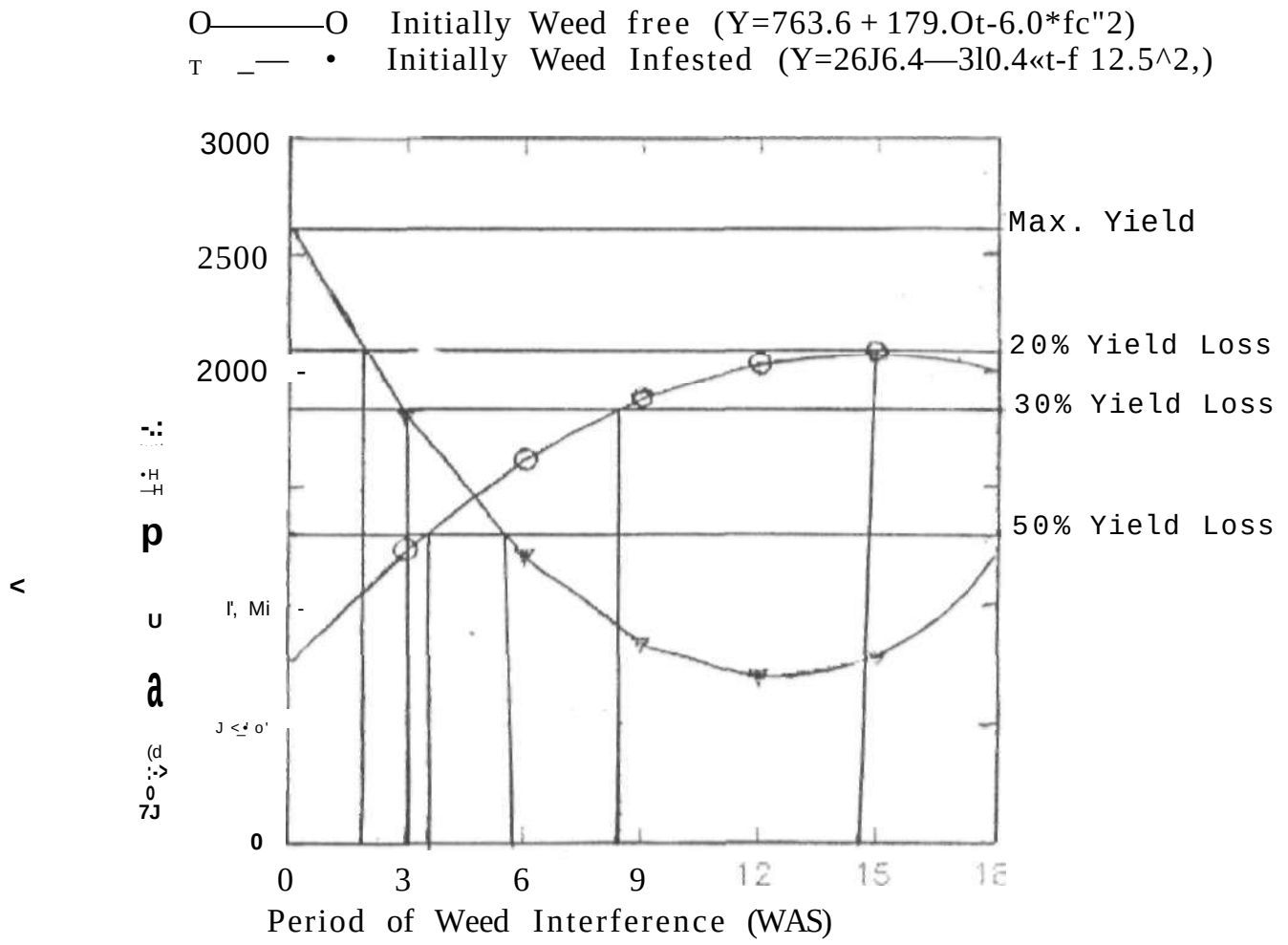


Fig.^ : Soyabean Grain Yield as Affected by Period of Weed Interference at Sarnaru, 1984 Wet Season

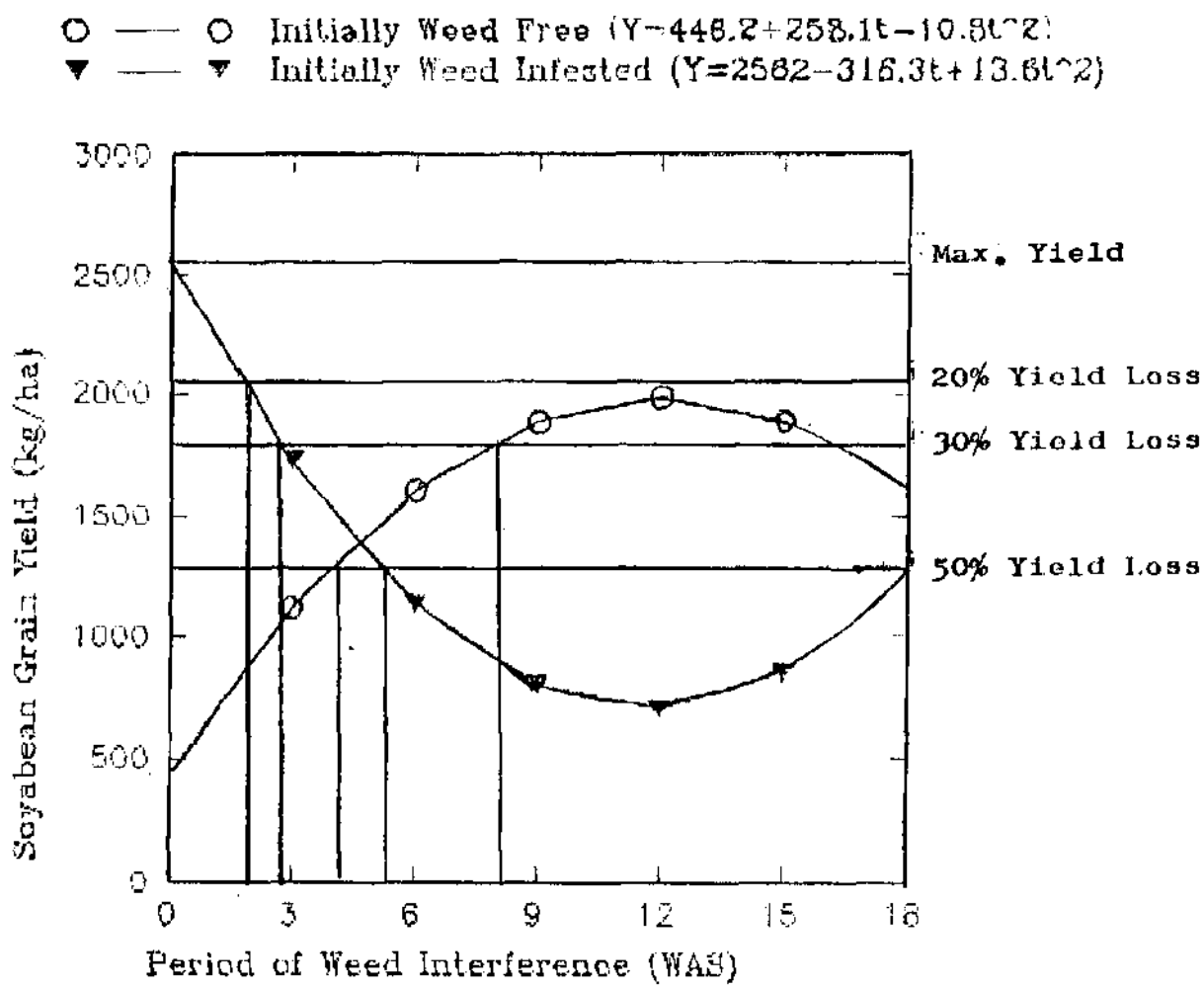


Fig. 2 : Soyabean Grain Yield as Affected by Period of Weed Interference at Samaru, 1985 Wet Season

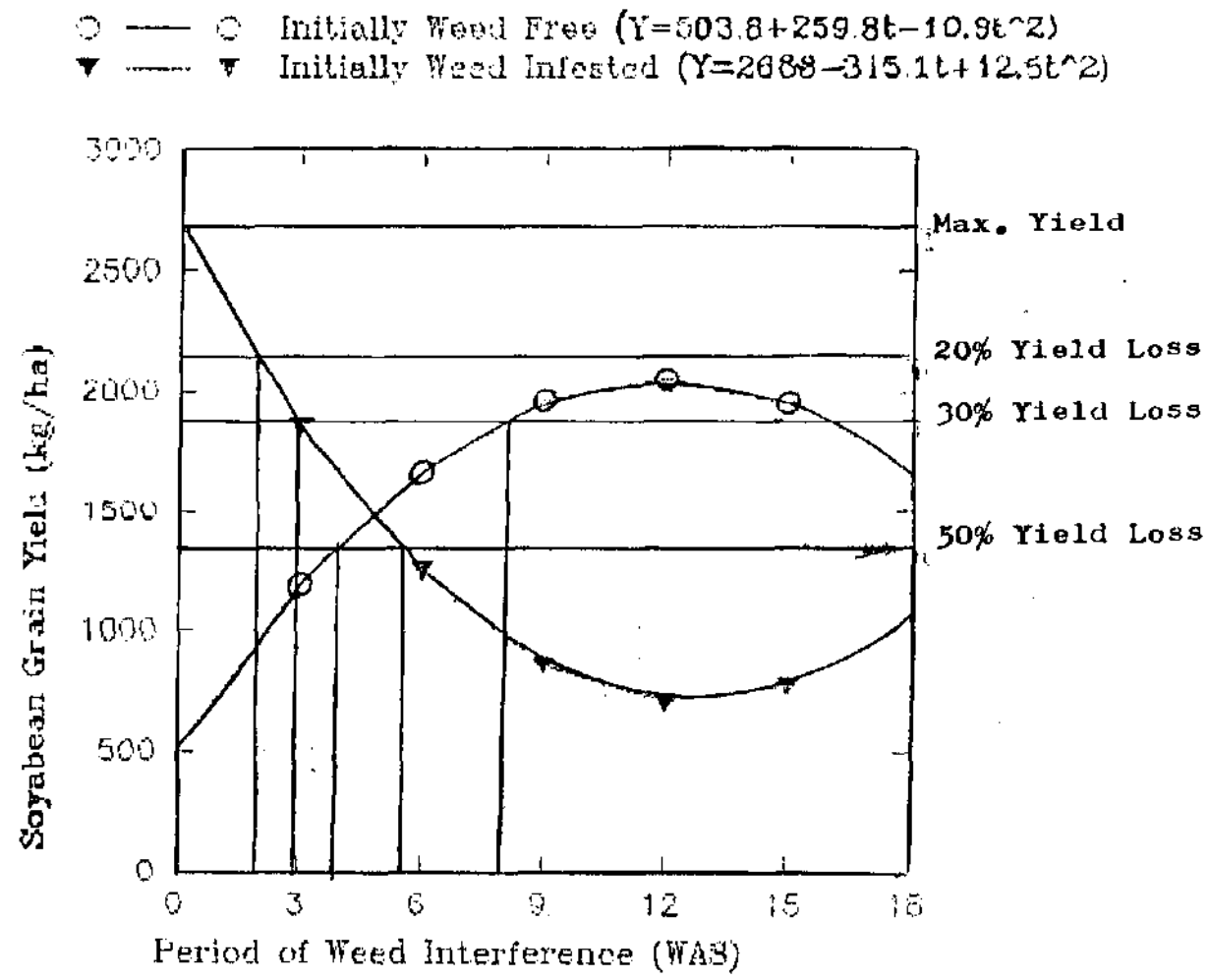


Fig. 3 : Soyabean Grain Yield as Affected by Period of Weed Interference at Samaru, 1986 Wet Season

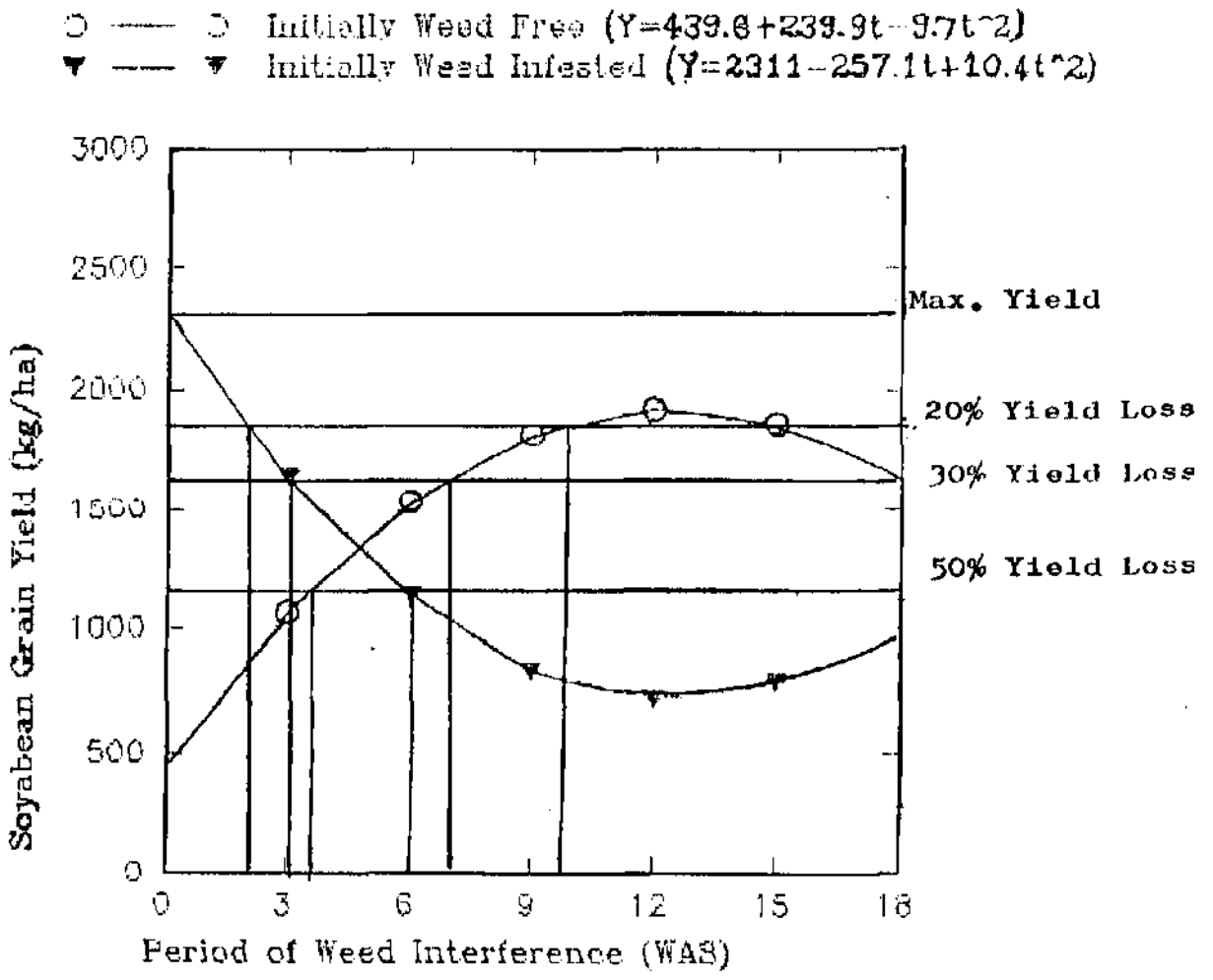


Fig 4 : Soyabean Grain Yield as Affected by Period of Weed Interference at Samaru, 1988 Wet Season

4.1.12 Relationship between various parmeters and soyabean grain yield in the weed interference studies

4.1.12.1 **Correlation coefficient**

In all the trials (Tables 69 to 72) soyabean grain yield was positively correlated with number of branches per plant, stand count at harvest, number of pods per plant and 1000 - grain weight (r = 0. 584, 0.491, 0.950, 0.845 respectively in 1984, 0.703, 0.257, 0.819, 0.756 respectively in 1985 0.715, 0.464, 0.918, 0.437 respectively in 1986 and 0.650, 0.537, 0.858, 0.678 respectively in 1988). Soyabean grain yield was also positively correlated with ground cover in 1984, 1985 and 1988 (r = 0.584, 0.514, -0.058, 0.647 in 1984,1985 and 1988, respectively).

In all the years, cumulative weed weight was negatively correlated with crop growth parameters viz number of branches/plant at 12 WAS, stand count at harvest, number of pods per plant and 1000 - grain weight (r = -0.309, -0.444, -0.438, -0.412 respectively in 1984, -0.347, -0.400, -0.528, and -0.336 respectively in 1985, -0.265, -0.228, -0.359, -0.087 respectively in 1986, -0.295, -0.503, -0.455, -0.304 respectively in 1988) Soyabean ground cover at 12 WAS was negatively correlated with cumulative weed dry weight in all years except in 1986 when the correlation was positive. (r = -0.388, -0.432, 0.185 -0.294 in 1984, 1985, 1986 and 1988, respectively).

Table 69: Correlation of weed dry weight, crop growth parameters and yield of soyabean as influenced by row spacing and weed interference periods at Samaru, 1984 wet season.

	Cumulative weed dry weight	No. of branches per plant	% ground cover	Stand count at harvest	No. of pods per plant	1000-grain weight	Grain yield
Cumulative weed dry wt	1.000						
No of branches at 12 WAS	-0.468xx	1.000					
% ground cover	-0.808xx	0.356xx	1.000				
Stand count at harvest	-0.741xx	0.303xx	0.662xx	1.000			
No. of pods/plant	-0.808xx	0.577xx	0.673xx	0.497xx	1.000		
1000-grain weight	-0.749xx	0.476xx	0.662xx	0.420xx	0.811xx	1.000	
Grain yield	-0.809xx	0.584xx	0.660xx	0.491xx	0.950xx	0.845xx	1.000

Values of 0.156 (P = 5%) and 0.204 (P =1%) are significant.

Table 70: Correlation of weed dry weight, crop growth parameters and yield of soyabean as influenced by row spacing and weed interference periods at Samaru, 1985 wet season.

	Cumulative weed dry weight	No. of branches per plant	% ground cover	Stand count at harvest	No. of pods per plant	1000-grain weight	Grain yield
Cumulative weed dry wt	1.000						
No. of branches at 12 WAS	-0.587xx	1.000					
% ground cover	-0.780xx	0.416xx	1.000				
Stand count at harvest	-0.567xx	0.300xx	0.522xx	1.000			
No. of pods/plant	-0.838xx	0.682xx	0.674xx	0.426xx	1.000		
1000-grain weight	-0.725xx	0.601xx	0.749xx	0.394xx	0.746xx	1.000	
Grain yield	-0.701xx	0.703xx	0.514xx	0.257xx	0.819xx	0.756xx	1.000

Values of 0.156 (P = 5%) and 0.204 (P = 1%) are significant.

Table 71: Correlation of weed dry weight, crop growth parameters and yield of soyabean as influenced by row spacing and weed interference period at Samaru, 1987 wet season

	Cumulative weed dry weight	No of branches per plant	% ground cover	Stand count at harvest	No. of pods per plant	1000-grain weight	Grain yield
Cumulative weed dry wt	1.000						
No of branches at 12 WAS	-0.571xx	1.000					
% ground cover	0.062	0.065	1.000				
Stand count at harvest	-0.529xx	0.290xx	0.016	1.000			
No. of pods/plant	-0.831xx	0.666xx	-0.034	0.526xx	1.000		
1000 - grain weight	-0.387xx	0.338xx	-0.041	0.292xx	0.417xx	1.000	
Grain yield	-0.813xx	0.715xx	-0.058	0.464xx	0.918xx	0.437xx	1.000

Values of 0.156 (P = 5%) and 0.204 (P = 1%) are significant.

Table 72: Correlation of weed dry weight crop growth parameters and yield of soyabean as influenced by row spacing and weed interference period at Samaru, 1988 wet season

	Cumulative weed dry weight	No of branches per plant	% ground cover	Stand count at harvest	No.of pods per plant	1000-grain weight	Grain yield
Cumulative weed dry weight	1.000						
No. of branches at 12 WAS	-0.517xx	1.000					
% ground cover at 12 WAS	-0.697xx	0.384xx	1.000				
Stand count at harvest	-0.728xx	0.397xx	0.575xx	1.000			
No. of pods per plant	-0.737xx	0.567xx	0.616xx	0.523xx	1.000		
1000-grain weight	-0.577xx	0.468xx	0.621xx	0.541xx	0.578xx	1.000	
Grain yield	-0.755xx	0.650xx	0.647xx	0.537xx	0.858xx	0.678xx	1.000

Values of 0.156 (P = 5%) and 0.204 (P = 1%) are significant.

4.1.12.2. **Path Coefficient**

Table 73 and Figures 5-8 show the path coefficient between grain yield and yield characters as well as the direct and indirect contributions of the yield characters to the grain yield. The number of pods per plant gave the highest direct contribution to grain yield in all the trials (0.745 in 1984, 0.458 in 1985, 0.776 in 1986 and 0.614 in 1988). This was followed by 100-grain weight in all the years except in 1986 when contribution of the number of branches per plant was higher than that of 100-grain weight.

In Figures 5-8, the indirect contribution of number of branches per plant through number of pods per plant on soyabean grain yield was highest in all the years compared with the contribution through 1000-grain weight. The indirect contribution of number of pods per plant to yield through 1000-grain weight was higher than through number of branches per plant in 1984, 1985 and 1988.

In 1986 however, the indirect contribution through number of branches was higher than that via 1000-grain weight. The indirect contribution of 1000-grain weight through number of pods per plant on soyabean grain yield was much higher (0.604 in 1984, 0.342 in 1985, 0.324 in 1986 and 0.355 in 1988) than through number of branches per plant (0.024, in 1984, 0.133 in 1985, 0.061 in 1986 and0.090 in 1988).

Table 73: Direct and indirect contributions of different attributes on soyabean grain yield in the weed competition trials at Samaru

Yield attributes	Contributions			
Number of branches per plant and yield	1984	1985	1986	1988
Direct contributions of number of branches per plant	0.051	0.222	0.181	0.193
Indirect contributions via number of pods per plant	0.430	0.312	0.517	0.348
Indirect contributions via 1000-grain weight	0.011	0.169	0.018	0.109
Total contribution (Direct and indirect).	0.492	0.703	0.715	0.650
Number of pods per plant and yield				
Direct contribution of number of pods/plant	0.745	0.458	0.776	0.614
Indirect contribution via number of branches/plant	0.029	0.151	0.121	0.109
Indirect contribution via 1000-grain weight	0.176	0.210	0.22	0.135
Total contribution (Direct and indirect)	0.950	0.819	0.918	0.858
1000-grain weight and yield				
Direct contribution of 1000-grain weight	0.217	0.281	0.052	0.233
Indirect contribution via number of branches/plant	0.024	0.133	0.061	0.090
Indirect contribution via number of pods/plant	0.604	0.342	0.324	0.355
Total contribution (Direct and indirect)	0.845	0.756	0.437	0.678

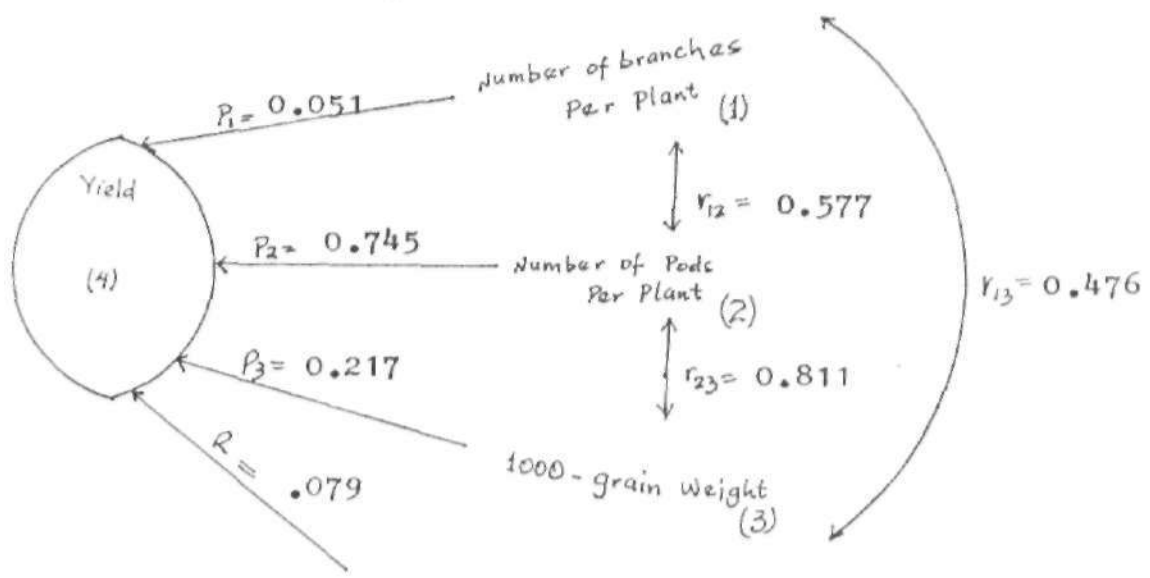


Fig. 5: Path diagram showing inter relations of grain yield of soyabean and some of its yield components in 1984.

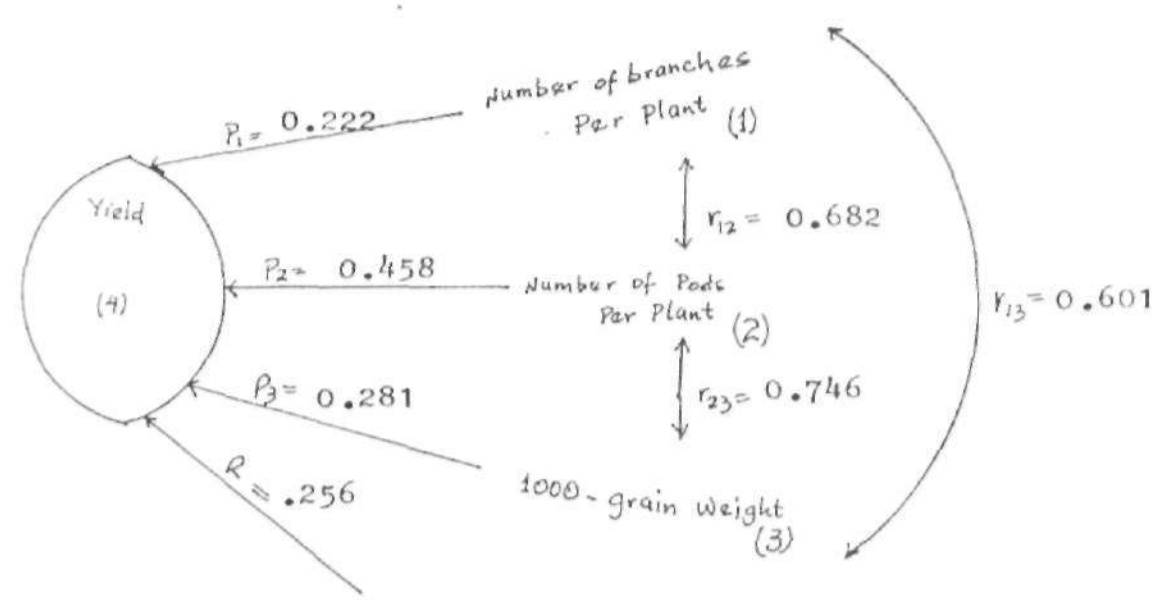


Fig. 6: Path diagram showing interrelations of grain yield of soyabean and some of its yield components in 1985.

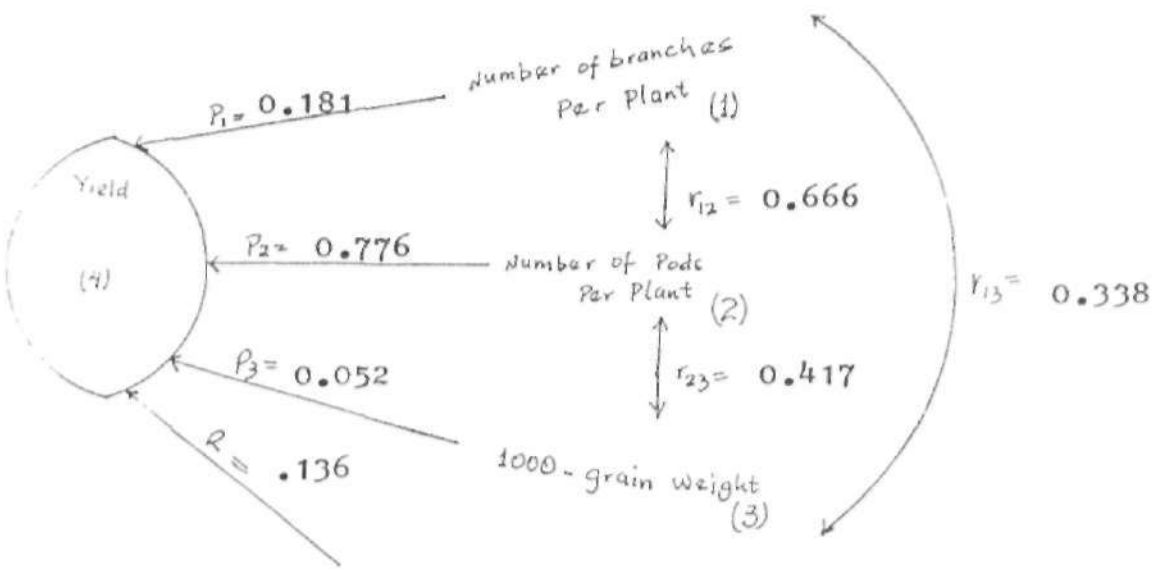


Fig. 7 : Path diagram showing interrelations of grain yield of soyabean and some of its yield components in 1986.

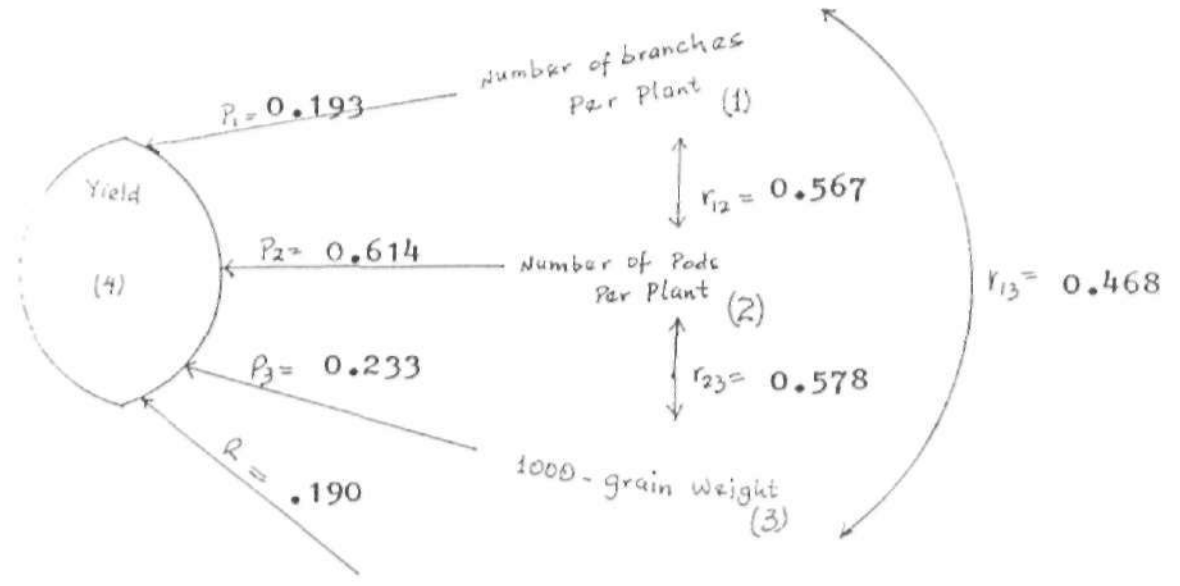


Fig. 8 : Path diagram showing interrelations of grain yield of soyabean and some of its yield components in 1988.

4.1.12.3 Percentage contribution

The percentage contribution of the yield attributes, both individually and combined were examined in all the trials (Table 74). Among the individual contributions, the number of pods per plant made the highest contribution in all the years (55.5% in 1984, 21.0% in 1985, 60.2% in 1986 and 37.7% in 1988). This was followed by the contribution of 1000-grain weight which ranged from 0.3% in 1986 to 7.9% in 1985. The least percentage contribution was from the number of branches per plant which was 0.3, 4.9, 3.3 and 3.7% in 1984, 1985, 1986 and 1988, respectively. The individual contribution in each year showed that number of pods per plant made the highest percentage contribution to yield followed by 1000-grain weight while the percentage contribution by number of branches per plant was highest than that of 1000-grain weight.

The number of pods per plant and 1000-grain weight made the highest combined contribution to yield in all the years (26.2, 19.2, 3.4 and 16.5% in 1984, 1985, 1986 and 1988 respectively).

This was followed by the combined percentage contribution of number of branches per plant and pods per plant which was highest in 1986 (18.7%) followed by that in 1985 (13.9%), 1988 (13.4%) and 1984 (4.4%). The least percentage contribution of any two combined yield attributes was from number of branches per plant and 1000-grain weight which was found to be 1.1, 7.5, 0.6 and 4.2% in 1984, 1985, 1986 and

1988, respectively.

Among the combined attributes number of pods per plant and 1000-grain weight had highest contribution to yield in 1984, 1985 and 1988. In 1986, however number of branches per plant and pods per plant made the highest combined contribution to yield (18.7%) followed by number of pods per plant and 1000-grain weight, while the least combined contribution was from the combination of number of branches per plant and 1000-grain weight. The unaccounted residual percentage contribution varied from 7.9% 1984 to 25.6% in 1985.

Table 74: The percentage contribution of different yield characters to yield in the weed competition trials at Samaru

Yield attributes	Percentage contribution			
Individual contributions	1984	1985	1986	1988
Number of branches/plant	0.26	4.93	3.28	3.72
Number of pods/plant	55.50	20.98	60.22	37.70
1000-grain weight	4.71	7.90	0.27	5.43
Combined contributions				
Number of branches/plant and 1000-grain	4.38	13.87	18.71	13.44
Number of branches/plant and 1000-grain weight	1.05	7.50	0.64	4.21
Number of pods/plant and 1000-grain weight	26.22	19.20	3.37	16.50
Residual	7.90	25.64	13.55	18.97
Total	100.00	100.04	100.04	100.01

.2 Effects of row spacing and weed control treatments on growth and yield of soyabean

The effects of weed control treatments and row spacing on the establishment, growth, yield and yield components of soyabean as well as weeds are shown in Tables 75 to 144

.2.1 Weed dry weight

Both row spacing and weed control treatments had significant effects on weed dry weights (WDW) in all the years of study (Tables 75 to 78). The interaction of row spacings and weed control treatments on wdw was also significant at 6 and 12 WAS in 1984, WAS and at harvest in 1985, 9 and 12 WAS and at harvest in 1986, and 9 and 12 WAS in 1988 (Tables 79 to 86).

Weed weights increased up to 12 WAS in all the years of study. At 9 WAS in 1984, 12 WAS in 1984 and 1986 and at harvest in 1986 and 1988 wdw increased with row spacing. Although weed weight at 45 (referring to inter-row and intra-row spacings of 45cm x 8.33cm) and 60cm (referring to inter-row and intra-row spacings of 60cm x 6.25cm) spacings were similar at 6 WAS in 1984, 1985 and 1988 it increased with row spacing from 60 to 90cm (referring to inter-row and intra-row spacings 90cm x 4.17cm). At harvest in 1984 the weed weights obtained from 75 (referring to inter-row and intra-row spacings 75cm x 5.00cm) and 90cm row spacings were also significantly higher than the comparable values of 45 and 60cm

spacings. At 6 and 12 WAS and harvest in 1985 weed dry matter production under the row spacing of 45, 60 and 75cm were similar and significantly lower than that of 90cm row spacing. Inspite of similar trend, 45cm row spacing caused lower weed dry matter production than the other row spacings at 12 WAS while WDW under 90cm row spacing was only higher than that of 45 and 60cm row spacing.

In all trials the weed control treatments including the hoe-weeded control, resulted in significantly lower wdw than the weedy check. In all the years, except 1984, all the herbicide treatments resulted in significantly higher wdw at 6 WAS before SHW compared with the hoe-weeded control. In 1984, weed dry weights at 6 WAS obtained with Galex at 3.0kg a.i/ha was comparable to that of the hoe-weeded control and significantly lower than that of Galex at 1.5kg a.i/ha. In this year wdw at 9 and 12 WAS and harvest were significantly higher with Galex at 1.5kga.i/ha alone compared with other weed control treatments. No differences were however observed between the herbicide rates supplemented with hoe-weeding at 6 WAS. The treatments with SHW also resulted in comparable weed weights with the hoe -weeded control. In 1985 and 1988, SHW of both herbicide rates and two hoe-weedings at 3 and 6 WAS resulted in similar weed weights that were significantly lower than the corresponding herbicide rates applied alone. In 1986, Galex at 1.5kg a.i/ha resulted in higher wdw at 9 and 12 WAS than Galex at 3.0kg a.i/ha alone, while SHW both rates of

the herbicides at the two sampling stages and at harvest further depressed weed dry matter.

The interaction of row spacing and weed control treatment was significant at 6 and 12 WAS in 1984 (Tables 79 and 82), 9 WAS and at harvest in 1985 (Tables 85) 9 and 12 WAS and at harvest in 1986 (Tables 80, 83 and 86) and 9 and 12 WAS in 1988 (Tables 81 and 84). Interaction of row spacing and weed control treatments at 6 WAS in 1984 showed that hoe-weeded control resulted in lower WDW than the weedy check at 60 to 90cm row spacings but resulted in comparable WDW at 45cm spacing. Similarly, all the herbicide treatments resulted in lower wdm than the weedy check at 60 and 90cm spacings while only the high rate caused lower values at 75 cm spacing. Weed weight at row spacings of 75 and 90cm were significantly higher than those of closer spacings with the application of Galex at 1.5kga.i/ha and 45cm spacing only with Galex at 3.0kg a.i/ha and the weedy check. With hoe-weeding, weed weights at 60 to 90cm spacings were significantly higher than that at 45cm spacing.

At 9 WAS in 1986 and 1988 weed weights were similar under row spacings of 45 and 60cm but increased significantly with spacings from 60 to 90cm in the plots kept weedy throughout. In 1986 however, with herbicide application alone, weed weights under 75 and 90cm spacings were higher than those obtained with 45cm; differences among spacings when SHW and two hoe-weedings were done were not significant.

In 1988, 90cm spacing resulted in significantly higher weed weights compared with 45cm spacing on plots treated with Galex at 1.5kg a.i/ha followed by SHW and Galex at 3.0kg a.i/ha alone. With the application of Galex at 3.0kg a.i/ha followed by SHW, both 75 and 90cm caused higher wdw compared with 45cm row spacing. Row spacing of 90cm resulted in higher weed weight than all other spacings in the plots hoe-weeded twice.

At 12 WAS, in 1984, with Galex at 3.0kga.i/ha alone weed weight at 45cm spacing was significaly lower than at 75 and 90 cm spacing, while with Galex at 3.0 kg a.i/ha followed by SHW weed weight in 45, 60 and 75cm row spacings was comparable but significantly lower than that in 90cm spacing. With the weedy check each increase in spacing significantly increased weed dry weight. In 1986 wdm in 45cm row spacing was lower than that in 90cm row spacing except in plots treated with Galex at 3.0kg a.i/ha followed by SHW and the hoe weeded control. In 1988 in all the weed control treatments including the weedy check, 90cm spacing caused higher WDW than 45 and 60cm while on differences were observed in the hoe-weeded control. Row spacing of 75cm also resulted in higher WDW than 45cm with Galex at 1.5kg a.i/ha followed by SHW and the weedy check. Row spacing of 60cm only caused higher WDW than 45cm in the weedy check (Table 84).

At harvest in 1985 WDW obtained from row spacing of 90cm was significantly higher than of 45cm on plots treated with

Galex at 1.5kg a.i/ha with or without SHW and the weedy check (Table 85). No differences were observed among spacings, in the other weed control treatments. In the plots kept weedy throughout, soyabean at 90cm spacing also had significantly higher WDW than at 60 and 75cm row spacings. In 1986, 90cm row spacing resulted in higher weed weight than all the other spacings without SHW of herbicide treatments and higher WDW than 45 and 60cm row spacings with SHW. In the hoe-weeded control 90cm row spacing had wdw comparable to 60 and 75cm row spacing but significantly higher than that of 45cm row spacings. In the plots kept weedy throughout both 75 and 90cm spacings caused higher wdw than 45 and 60cm.

Table 75: Effects of row spacing and weed control on weed dry weight of soyabean at Samaru, 1984 wet season.

Treatments	Weed dry weight (t/ha) at 6 WAS[1]	9 WAS	12 WAS	harvest
Inter-row and intra-row spacings (I)				
	[2]			
45cm x 8.33cm	1.5c	1.8d	2.8d	2.2b
60cm x 6.25cm	1.6c	2.2c	3.3c	2.7b
75cm x 5.00cm	2.0b	2.7b	3.8b	3.7a
90cm x 4.17cm	2.4a	3.3a	4.3a	3.5a
S.E (±)	0.08	0.11	0.11	0.26
	[3]			
Weed control treatment (W)				
	[4]			
Galex at 1.5kg a.i/ha	2.2b	3.0b	3.9b	4.2b
	[5]			
Galex at 1.5kg a.i/ha fb				
	[6]			
SHW at 6 WAS	2.3b	1.2d	1.6d	1.1d
Galex at 3.0kg a.i/ha	1.5c	2.5c	3.3c	3.1c
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	1.5c	0.9d	1.6d	0.9d
Hoe-weeded at 3 and 6 WAS (Control)	1.0c	1.2d	1.7d	0.7d
Weedy check	2.8a	6.3a	9.1a	8.2a
S.E (±)	0.10	0.13	0.14	0.32
Interaction				
		[7]		
I x W	*	NS	*	NS

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of using the Duncan's Multiple Range Test (DMRT)
3/ significant at 5% level of probability
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.
7/ Not significant

Table 76: Effects of row spacing and weed control on weed dry weight of soyabean at Samaru, 1985 wet season.

Treatments	Weed dry weight (t/ha) at 6WAS[1/]	9 WAS	12 WAS	harvest
Inter-row and intra-row spacings (i) [2/]				
45cm x 8.33cm	1.6b	2.1c	3.9b	3.2b
60cm x 6.25cm	1.8b	2.2c	4.3b	3.4b
75cm x 5.00cm	1.9b	2.5b	4.4b	3.5b
90cm x 4.17cm	2.2a	3.1a	5.3a	5.6a
S.E (±)	0.07 [3/]	0.09	0.22	0.26
Weed control treatment (W)				
Galex [4/] at 1.5kg a.i/ha	2.2b	3.4b	4.5b	5.0b
Galex at 1.5kg a.i/ha fb [5/] SHW [6/] at 6 WAS	2.1b	0.9c	2.5c	1.7c
Galex at 3.0kg a.i/ha	1.8c	3.2b	4.3b	4.7b
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	1.8c	0.8c	2.7c	1.5c
Hoe-weeded at 3 and 6 WAS (Control)	0.6d	1.0c	2.8c	1.7c
Weedy check	2.9a	5.6a	9.5a	8.9a
S.E (±)				
Interaction				
I x W	NS [7/]	NS	NS	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ significant at 5% level of probability
4/ Proprietory mixture of metolachlor pllus metobromuron in 1:1 ratio.
5/ Followed by
6/ supplementary hoe-weeding.
7/ Not significant

Table 77: Effects of row spacing and weed control on weed dry weight of soyabean at Samaru, 1986 wet season.

Treatments	Weed dry weight (t/ha) at 6 WAS[1]	9 WAS	12 WAS	harvest
Inter-row and intra-row spacings (I) [2]				
45cm x 8.33cm	1.4c	2.3c	3.9d	3.5d
60cm x 6.25cm	1.6bc	2.4c	4.1c	4.0c
75cm x 5.00cm	1.7b	2.8b	4.5b	4.8b
90cm x 4.17cm	2.0a	3.2a	4.9a	5.8a
S.E (±)	0.07	0.08	0.07	0.14
Weed control treatment (W)				
Galex [4] at 1.5kg a.i/ha	5.0bc	3.5b	4.9b	5.6b
Galex at 1.5kg a.i/ha fb [5] SHW [6] at 6 WAS	2.0b	0.7d	2.5de	2.7c
Galex at 3.0kg a.i/ha	1.3d	3.1c	4.7c	5.1b
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	1.4d	0.7d	2.3e	2.1d
Hoe-weeded at 3 and 6 WAS (Control)	0.7e	0.8d	2.6d	2.2d
Weedy check	2.7a	7.1a	9.1a	9.7a
S.E (±)	0.08	0.10	0.09	0.17
Interaction				
I x W	NS [7]	* [3]	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ significant at 5% level of probability
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding. 7/ Not significant

Table 78: Effects of row spacing and weed control on weed dry weight of soyabean at Samaru, 1988 wet season.

Treatments	Weed dry weight (t/ha) at 6 WAS[1/]	9 WAS	12 WAS	harvest
Inter-row and intra-row spacings (I)				
	[2/]			
45cm x 8.33cm	0.9c	1.9d	3.8c	3.9d
60cm x 6.25cm	1.0bc	2.1cd	4.4b	4.3c
75cm x 5.00cm	1.2ab	2.5b	4.7b	4.9b
90cm x 4.17cm	1.3a	3.0a	5.3a	5.5a
S.E (±)	0.07	0.07	0.12	0.15
	[3/]			
Weed control treatment (W)				
Galex [4/] at 1.5kg a.i/ha	1.1b	2.7b	4.3b	5.3b
Galex at 1.5kg a.i/ha fb [5/] SHW [6/] at 6 WAS	1.1b	0.8c	2.3c	2.2c
Galex at 3.0kg a.i/ha	0.7c	2.6b	4.0b	5.1b
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	0.7c	0.8c	2.1c	2.0c
Hoe-weeded at 3 and 6 WAS (control)	0.4d	0.9c	2.3c	2.3c
Weedy check	2.6a	6.4a	12.1a	11.0a
Interaction				
	[7/]			
I x W	NS	*	*	NS

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT)
3/ significant at 5% level of probability.
4/ Proprietory mixture of metolachlor plus metobromuron in 1.1 ratio.
5/ Followed by 6/ supplementary hoe-weeding. 7/ Not significant

Table 79: Interaction of row spacing and weed control treatment on weed dry weight of soyabean at 6 WAS at Samaru, 1984 wet season.

Weed control treatment	Weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	1.5d-h [2]	1.9de	2.5bc	2.9b
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	1.6d-g	1.8de	2.6b	3.0b
Galex at 3.0kg a.i/ha	1.0ghi	1.3e-i	1.8de	1.9de
Galex at 3.0kg a.i/ha fb SHW 6 WAS	1.1f-i	1.4d-h	1.7def	1.8de
Hoe-weeded at 3 and 6 WAS (Control)	1.8de	0.7i	0.7i	0.9hi
Weedy check	2.0cd	2.5bc	2.9b	3.6a
S.E (±)	0.20			

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 80: Interaction of row spacing and weed control treatments on weed dry weight of soyabean at 9 WAS at Samaru, 1986 wet season.

Weed control treatment	Weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	3.0fg [2]	3.3ef	3.7de	4.0d
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	0.7h	0.7h	0.8h	0.7h
Galex at 3.0kg a.i/ha	2.5g	2.7fg	3.3ef	3.9de
Galex at 3.0kg a.i/ha fb SHW 6 WAS	0.6h	0.8h	0.7h	0.8h
Hoe-weeded at 3 and 6 WAS (control)	0.7h	0.8h	0.8h	0.9h
Wweedy check	6.0c	6.3c	7.3b	8.8a
S.E (±)		0.21		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 81: Interaction of row spacing and weed control treatments on weed dry weight of soyabean at 9 WAS at Samaru, 1988 wet season.

Weed control treatment	Weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	2.5de [2]	2.6de	2.8de	3.0d
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	0.4j	0.6hij	1.0f-i	1.2fg
Galex at 3.0kg a.i/ha	2.4e	2.5de	2.6de	3.0d
Galex at 3.0kg a.i/ha fb SHW 6 WAS	0.4j	0.7g-j	1.1fgh	1.1fgh
Hoe-weeded at 3 and 6 WAS (Control)	0.5ij	0.6hij	0.9g-j	1.5f
Weedy check	5.0c	5.0c	6.7b	8.4a
S.E (±)	0.18			

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 82: Interaction of row spacing and weed control treatments on weed dry weight of soyabean at 12 WAS at Samaru, 1984 wet season.

Weed control treatment	Weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Galex[1/] at 1.5kg a.i/ha	3.5ef[2/]	3.8e	4.0e	4.3e
Galex at 1.5kg a.i/ha fb[3/] SHW[4/] 6 WAS[5/]	1.1j	1.5ij	1.8hij	2.0g-j
Galex at 3.0kg a.i/ha	2.6gh	2.8fg	3.5ef	4.3e
Galex at 3.0kg a.i/ha fb SHW 6 WAS	1.2j	1.6ij	1.7ij	2.0gh
Hoe-weeded at 3and 6 WAS (Control)	1.3ij	1.5ij	1.7ij	2.2ghi
Weedy check	7.0d	8.7c	10.0b	10.8a
S.E (±)		0.28		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 83: Interaction of spacing and weed control treatments on weed dry weight of soyabean at 12 WAS at Samaru, 1986 wet season.

Weed control treatment	Weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	4.5ef [2]	4.8e	5.0de	5.4d
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	2.0k	2.4g-k	2.5g-k	2.9g
Galex at 3.0kg a.i/ha	4.2f	4.5ef	4.9de	5.0de
Galex at 30kg a.i/ha fb SHW 6 WAS	2.1jk	2.2ijk	2.3h-k	2.6g-j
Hoe-weeded at 3 and 6 WAS (Control)	2.3h-k	2.5g-k	2.7ghi	2.8gh
Weedy check	8.0c	8.4c	9.4b	10.5a
S.E (±)		0.18		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 84 : Interaction of row spacing and weed control treatments on weed dry weight of soyabean at 12 WAS at Samaru, 1988 wet season.

Weed control treatment	Weed drv weiqht (t/ha) Row spacing (cm) 45	60	75	'JO
Galex [1/] at 1.5kg a.i/ha	3.8fg [2/]	4.0ef	4.2def	5.0d
Galex at 1.5kg a.i/ha fb [3/] SHW [1/] 6 WAS [5/]	1.61	2.0jkl	2.5ijk	3.0ghi
Galex at 3.0kg a.i/ha	3.5fgh	3.8fg	4.Oef	4.8de
Galex at 3.0kg a.i/ha fb SHW 6 WAS	1.8kl	1.8kl	2.1jkl	2.8hij
Hoe-weeded at 3 and 6 WAS (Control)	2.0jkl	2.7hij	2.6hij	2.9hij
Weedy check	10.0c	12.1b	12.9ab	13.4a
S.E (+)		0.29		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 85: Interaction of row spacing and weed control treatments on weed dry weight of soyabean at harvest at Samaru, 1985 wet season.

Weed control treatment	Weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	4.1fgh [2]	4.6e-h	4.9d-g	6.2cde
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	1.2j	1.5ij	1.6hi	3.4ghi
Galex at 3.0kg a.i/ha	4.0fgh	4.5e-h	4.2e-h	5.9c-f
Galex at 3.0kg a.i/ha fb SHW 6 WAS	1.0j	1.3j	1.6ij	2.0ij
Hoe-weeded at 3 and 6 WAS (Control)	1.1j	1.9ij	1.1j	2.6hij
Weeded check	7.6bc	6.7bcd	8.3b	13.2a
S.E (±)		0.64		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 86: Interaction of row spacing and weed control treatments on weed dry weight of soyabean at harvest at Samaru, 1986 wet season.

Weed control treatment	Weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	4.2fg [2]	4.8ef	5.7e	7.5cd
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	1.7kl	2.4jk	3.0hij	3.5ghi
Galex at 3.0kg a.i/ha	4.0fgh	4.5f	5.0ef	7.0d
Galex at 3.0kg a.i/ha fb SHW 6 WAS	1.5l	1.3kl	2.2jkl	2.9ij
Hoe-weeded at 3 and 6 WAS (Control)	3.5l	2.0jkl	2.3jkl	2.9ij
Weedy check	8.1bc	8.7b	10.8a	11.2a
S.E (±)		0.34		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

4.2.2 Cumulative Weed dry Weight

The effect of row spacing and weed control treatments and their interactions on the cumulative weed dry weight (CWDW) were significant in all the years of study (Tables 87 to 91).

In 1984,1986 and 1988, CWDW increased with row spacing from 45cm to 90cm (Table 87) In 1985, 90cm spacing resulted in higher CWDW than the other row spacings while 75 and 60cm produced similar CWDW that was higher than that of 45cm.

In all trials, all the weed control treatments resulted in significantly lower CWDW than the weedy check. The herbicide treatments applied alone caused significantly higher total weed dry matter production than the corresponding rates supplemented with a hoe-weeding at 6 WAS. The hoe-weeded control produced CWDW comparable to herbicide treatments that received supplementary hoe-weeding in all the years except 1986.

Cumulative weed dry matter production of the hoe-weeded control was only comparable to that of Galex at 3.0kg a.i/ha fb SHW in 1986. Galex at 3.0kg a.i/ha resulted in lower CWDW than Galex at 1.5kg a.i/ha with or without SHW in 1984 and 1986 and without SHW in 1988.

The interaction showed that in 1984 (Table 88) with the application of Galex at 1.5kg a.i/ha alone higher cwdw was obtained at 90cm spacing compared with other row spacings. With the herbicide treatment, 45cm also resulted in lower CWDW

than 75cm spacing. However, with the application of Galex at 1.5kg a.i/ha followed by SHW and Galex at 3.0kg a.i/ha, CWDW at 90cm spacing was higher than at 45 and 60cm spacings. Row spacings of 75cm resulted in higher CWDW than 45cm spacing with the application of Galex at 1.5kg a.i/ha with and without SHW. Although Galex at 3.0kg a.i/ha alone caused higher CWDW at 75cm than at 45 and 60cm row spacings, when supplemented with hoe-weeding at 6 WAS both 75 and 90cm had similar CWDW but higher than at 45cm spacing. CWDW in plots hoe-weeded at 3 and 6 WAS did not differ significantly among spacings, while with the weedy check 75 and 90cm spacings had higher CWDW than 45 and 60cm spacings. Higer CWDW production was also obtained with 60cm row spacing compared with 45cm in the plots kept weedy throughout.

In 1985 (Table 89) with the application of Galex at 1.5kg a.i/ha with and without SHW and Galex at 3.0kg a.i/ha alone 90cm spacing caused higher CWDW than all other row spacings. However, with Galex at 3.0kg a.i/ha followed by SHW CWDW production in 75 and 90cm spacings were similar and higher than those caused by 45 and 60cm row spacings. Row spacing of 90cm caused higher CWDW than 45cm in the hoe-weeded ontrol and all the other spacings in the weedy plot. In the 75 and 90cm row spacings plots treated with Galex at 3.0kg a.i/ha followed by SHW produced higher CWDW than those treated with Galex at 1.5kg a.i/ha fb SHW.

In 1986 (Table 90) application of Galex at 1.5kg a.i/ha

alone and Galex at 3.0kg a.i/ha with and without SHW caused higher CWDW production in soyabean planted at 90cm spacing than closer spacings. However, with application of Galex at 1.5kg a.i/ha followed by SHW, the hoe-weeded control and the weedy check 90cm row spacing caused higher CWDW production than 45 and 60cm row spacings. The CWDW production in 75cm spacing was higher than 45 cm spacing in plots treated with Galex at 1.5 kg a.i/ha with and without SHW and 3.0kg a.i/ha alone. Application of Galex at 1.5kg a.i/ha followed by SHW also caused higher CWDW in 60cm than 45cm spacing.

At 60cm row spacing, plots treated with Galex at 1.5kg a.i/ha alone produced higher CWDW than those treated with Galex at 3.0kg a.i/ha alone. Similarly, with the hoe-weeded control and Galex at 3.0kg a.i/ha followed by SHW produced comparable CWDW but lower than Galex at 1.5kg a.i/ha followed by SHW.

In 1988 (Table 91) with application of Galex at 1.5kg a.i/ha alone CWDW in 75cm spacing was comparable to that in 60 and 90cm spacing but higher than that in 45cm spacing. However, with Galex at 1.5kg a.i/ha followed by SHW CWDW in 75 and 90cm spacings were similar and higher than 45 and 60cm spacings. Row spacing of 90cm resulted in higher CWDW than all the other spacings with the application of Galex at 3.0kg a.i/ha alone and 60 and 45cm when the herbicide was followed by SHW. In the hoe-weeded control CWDW production 75 and 90cm spacing was higher than in 45cm spacing while the parameter

increased significantly with row spacing in the weedy check.

In the 75cm row spacing, plots treated with Galex at 1.5kg a.i/ha fb SHW produced higher CWDW than those treated with Galex at 3.0kg a.i/ha fb SHW.

Table 87: Effects of row spacing and weed control treatment on cumulative weed dry weight in soyabean at samaru, 1984 - 1988 wet season.

Treatments	1984	1985	1986	1988
Inter-row and intra-row spacings (I) [1/]				
45cm x 8.33cm	11.0d	11.38c	14.0d	12.9d
60cm x 5.25cm	12.9c	15.2b	16.1c	14.5c
75cm x 5.00cm	15.5b	15.6b	17.1b	15.9b
90cm x 4.17cm	16.4a	20.6a	19.9a	17.8a
S.E (±)	0.25	0.41	0.22	0.22
Weed control treatment (W)				
Galex [3/] at 1.5kg a.i/ha	16.0b	17.9b	18.8b	15.8b
Galex at 1.5kg a.i/ha fb [4/] SHW [5/] at 6 WAS [6/]	8.9d	10.11c	12.1d	9.3d
Galex at 3.0kg a.i/ha	12.5c	16.8b	16.7c	14.5c
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	7.8e	11.1c	9.5e	8.4d
Hoe-weeded at 3 and 6 WAS (Control)	8.1de	10.2c	10.5e	9.1d
Weedy check	30.2a	31.5a	33.0a	34.7a
S.E (±)	0.37	0.51	0.43	0.31
Interaction				
I x W [2/]	*	*	*	*

1/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
2/ significant at 5% level of probability
3/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
4/ Followed by 5/ supplementary hoe-weeding. 6/ Weeks after sowing
7. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 88: Interaction of row spacing and weed control treatments on cumulative weed dry weight in Soyabean at Samaru, 1984.

Weed control treatment	Cumulative weed dry weight (t/ha) Row spacings (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	13.1fg [2]	15.0ef	16.7e	19.3d
Galex at 1.5kg a.i/ha fb [3] SHW [4] at 6 WAS [5]	6.2kl	8.4ijk	9.9hi	11.2gh
Galex at 3.0kg a.i/ha	9.3hij	11.4gh	14.5f	15.0ef
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	5.7l	7.0jkl	9.1hij	9.3hij
Hoe-weeded at 3 and 6 WAS (Control)	7.8i-l	7.4jkl	8.0i.l	9.2hij
Weedy check	24.1c	28.6b	33.7a	34.2a
S.E (±)		0.713		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 89: Interaction of row spacing and weed control treatments on cumulative weed dry weight in soyabean at Samaru, 1985.

Weed control treatments	Cumulative weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	15.7fg [2]	17.0ef	18.1ef	21.2d
Galex at 1.5kg a.i/ha fb [3] SHW [4] at 6 WAS [5]	8.8k	9.6jk	8.8k	13.3ghi
Galex at 3.0kg a.i/ha	15.3fgh	16.2fg	15.7fg	19.9de
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	8.7k	10.0jk	9.6fg	16.6f
Hoe-weeded at 3 and 6 WAS (Control)	8.5k	10.7ijk	9.5jk	12.3hij
Weedy check	26.7c	27.8c	31.6b	40.1a
S.E (±)		1.014		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 90: Interaction of row spacing and weed control treatments on cumulative weed dry weight in soyabean at Samaru, 1986.

Weed control treatment	Cumulative weed dry weight (t/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	16.0ghi [2]	17.5fg	19.3ef	22.5d
Galex at 1.5kg a.i/ha fb SHW [3] at 6 WAS [4]	8.8n	15.7ghi	11.4klm	12.6jk
Galex at 3.0kg a.i/ha	14.2ij	14.9hij	17.1fgh	25.5de
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	7.8n	8.8n	9.1lmn	12.6jk
Hoe-weeded at 3 and 6 WAS (Control)	8.9mn	9.9lmn	11.6kl	11.6kl
Weedy check	28.5c	30.0c	33.7a	39.2a
S.E (±)		0.806		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
   SHW at 6 WAS
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 91: Interaction of row spacing and weed control treatments on cumulative weed dry weight in soyabean at Samaru, 1988.

Weed control treatments	Cumulative weed dry weight (t/ha) Row spacings (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	13.7hi [2]	14.6fgh	16.4efg	18.1e
Galex at 1.5kg a.i/ha fb SHW [3] at 6 WAS [4] [5]	7.0o	7.9mno	11.0jk	11.3j
Galex at 3.0kg a.i/ha	13.0i	13.8hi	14.8ghi	16.5ef
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	6.5o	8.2mno	9.0lmn	10.1jkl
Hoe-weeded at 3 and 6 WAS (Control)	7.7no	8.9lmn	9.1klm	10.6jkl
Weedy check	29.8d	33.5c	35.2b	40.3a
S.E (±)		0.603		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatement are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

4.2.3 **Stand count**

The weed control treatments had significant effect on stand count in all the trials except at 6 WAS in 1986 (Tables 92 to 95). Soyabean stand count with all the herbicide treatments and hoe-weeded control was significantly higher than that of the weedy check at 6 WAS in 1984 and at harvest in all the years of the trial. No differences in stand count were observed among herbicide treatments and the hoe-weeded control at 6 WAS in 1984 and at harvest in 1984,1985 and 1988. At 6 WAS in 1985 all the herbicide treatments with the exception of Galex at 3.0kg a.i/ha resulted in significantly lower stand count of soyabean compared with the hoe-weeded control. Galex at 3.0kg a.i/ha alone had comparable stand count with all other herbicides treatments and the weedy check. Significantly lower soyabean stand count than the hoe-weeded control were also observed with Galex at 1.5kg a.i/ha alone and Galex at 3.0kg followed by SHW at harvest in 1986 and 6 WAS in 1988. SHW only affected stand count of soyabean at 6 WAS in 1988 and at harvest in 1986 when it depressed stand count after the application of Galex at 1.5kg a.i/ha and Galex at 3.0kg a.i/ha, respectively. The interaction of row spacing and weed control treatments on soyabean stand count was significant at harvest in 1986 and 1988 (Tables 96 and 97). The maximum soyabean stand count was obtained at 45cm row spacing in plots hoe-weeded at 3 and 6 WAS while comparable stand count to the maximum were obtained

in plots treated with Galex at 1.5kg a.i/ha with and without SHW, Galex at 3.0kg a.i/ha alone at 45cm row spacing, Galex at 1.5 and 3.0kga.i/ha alone and the hoe-weeded control at 60cm spacing. At 45 and 60cm row spacing plots treated with Galex at 3.0kg a.i/ha fb SHW did not give comparable stand count to the appropriate maxima at each spacing. At 90cm row sapcing, Galex at 1.5kga.i/ha alone resulted in lower stand count than the appropriate maximum while no differences in soyabean stand count were observed among the herbicide and how-weeded treatments in 75cm row spacing. Although in the hoe-weeded control soyabean stand count at 45cm spacing was higher than at 75 and 90cm spacing, in the weedy check stand count decreased with increase in row spacing up to 75cm.

At harvest in 1988 among all the treatments only Galex at 3.0kga.i/ha alone at 45cm row spacing caused comparable stand count to the maximum obtained with the hoe-weeded control at the same spacing (Table 98). With all the herbicide treatments stand count did not differ significantly among the row spacings. At 45cm row spacing, plots hoe-weeded at 3 and 6 WAS (control) had higher soyabean stand count than those treated with Galex at 1.5kg a.i/ha with and without SHW and at 3.0kg a.i/ha followed by SHW.

Table 92: Effects of row spacing and weed control treatments on stand count of soyabean at Samaru, 1984 wet season.

Treatments	Stand count per $10m^2$ at 1/ 6 WAS	harvest
Inter-row and intra-row spacings (I)		
45cm x 8.33cm	264.3	265.0
60cm x 6.25cm	262.7	265.6
75cm x 5.00cm	263.4	265.1
90cm x 4.17cm	263.4	262.1
S.E (+)	4.35	2.72
Weed control treatment (W)		
Galex 4/ at 1.5kg a.i/ha	265.1a 3/	263.9a
Galex at 1.5 a.i/ha fb 5/ SHW 6/ at 6 WAS	261.4a	263.3a
Galex at 3.0kg a.i/ha	265.1a	264.5a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	265.2a	265.6a
Hoe-weeded at 3and 6 WAS (Control)	265.6a	262.8a
Weedy check	241.3b	220.5b
S.E (±)	5.33	3.32
Interaction I x W	NS	NS

1/ Weeks after sowing
2/ Not significant
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

Table 93: Effect of spacing and weed control treatment on stand count of soyabean at Samaru, 1985 wet season.

Treatments	stand count per $10m^2$ at 6WAS 1/	harvest
Inter-row and intra-row spacings (I)		
45cm x 8.33cm	265.1	262.1
60cm x 6.25cm	265.2	262.2
75cm x 5.00cm	265.2	258.5
90cm x 4.17cm	264.8	260.8
S.E (±)	0.21	1.26
Weed control treatment (W)		
Galex 4/ at 1.5 a.i/ha	264.5b 3/	263.3a
Galex at 1.5kg a.i/ha fb 5/ SHW 6/ at 6 WAS	265.0b	260.3a
Galex at 3.0kg a.i/ha	265.5ab	263.8a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	265.0b	264.3a
Hoe-weeded at 3 and 6WAS (Control)	265.9a	263.8a
Weedy check	264.5b	250.1b
S.E. (±)	0.26	1.54
Interaction I x W	2/ NS	NS

1/ Weeks after sowing
2/ Not significant
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

Table 94: Effects of row spacing and weed control treatment on stand count of soyabean at Samaru, 1986 wet season.

Treatments	stand count per $10m^2$ at 6WAS [1]	harvest
Inter-row and intra-row spacings (I)		
45cm x 8.33cm	264.9	262.6
60cm x 6.25cm	265.1	262.2
75cm x 5.00cm	264.8	262.0
90cm x 4.17cm	265.5	262.7
S.E (±)	0.27	0.27
Weed control treatment (W)		
Galex [4] at 1.5kg a.i/ha	265.2	262.5bc [3]
Galex at 1.5kg a.i/ha fb SHW [5] [6] at 6 WAS	265.5	263.0ab
Galex at 3.0kg a.i/ha	265.0	263.2ab
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	265.4	262.0c
Hoe-weeded at 3 and 6 WAS (Control)	264.3	263.5a
Weedy check	265.00	249.5d
S.E. (±)	0.33	0.33
Interaction I x W	NS [2]	* [7]

1/ Weeks after sowing
2/ Not significant
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Propritory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by w supplementary hoe-weeding. 7/ significant at 5%level of probability

Table 95: Effects of row spacing and weed control treatment on stand count of soyabean at Samaru, 1988 wet season.

Treatments	Stand count per $10m^2$ at 6 WAS[1]/	harvest
Inter-row and intra-row spacings (I)		
45cm x 8.33cm	265.0	262.1
60cm x 6.25cm	265.2	261.6
75cm x 5.00cm	264.7	261.8
90cm x 4.17cm	264.5	261.7
S.E (±)	0.25	0.36
Weed control treatment (W)		
		3/
Galex 4/ at 1.5kg a.i/ha	264.2bc	262.4a
Galex at 1.5kg a.i/ha fb 5/ SHW 6/ at 6 WAS	265.5a	262.3a
Galex at 3.0kg a.i/ha	265.0ab	262.8a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	264.5bc	262.0a
Hoe-weeded at 3 and 6 WAS (Control)	265.8a	263.0a
Weedy check	264.0c	254.8b
S.E. (±)	0.30	0.44
Interaction		
	2/	7/
I x W	NS	*

1/ Weeks after sowing
2/ Not significant
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding. 7/ significant at 5% level of probability

Table 96: Interaction of row spacing and weed control treatments on stand count of soyabean at harvest at Samaru, 1986 wet season.

Weed control treatment	Stand count per $10m^2$ Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	264ab[2]	264ab	262cd	260e
Galex at 1.5kg a.i/ha fb [3]				
SHW [4] 6 WAS [5]	265a	263bc	263bc	261de
Galex at 3.0kg a.i/ha	264ab	264ab	263bc	262cd
Galex at 3.0kg at fb SHW 6 WAS	263bc	262cd	262cd	261de
Hoe-weeded at 3 and 6 WAS (control)	265a	264ab	263bc	262cd
Weedy check	255f	252g	246h	245h
S.E (±)		0 .67		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different oat 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 97: Interaction of row spacing and weed control treatment on stand count of soyabean at harvest at Samaru, 1988 wet season.

Weed control treatment	Stand count per $10m^2$ Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	262bc [2]	261c	263bc	261c
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	262bc	263bc	262bc	262bc
Galex at 3.0kg a.i/ha	264ab	262bc	262bc	263bc
Galex at 3.0kg a.i/ha fb SHW 6 WAS	263bc	262bc	261c	262bc
Hoe-weeded at 3 and 6 WAS (control)	266a	261c	262bc	263bc
Weedy check	256d	255de	255de	253e
S.E (±)	0.87			

1. proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

4.2.4 **Plant height**

Inter-row spacing significantly affected soyabean plant height at 6 and 9 WAS in 1984 and 1986 and 12 WAS in 1985 (Tables 98 to 101). In all the trials, 45cm row spacing resulted in taller plants than 90cm spacing. In 1984 and at 9WAS in 1986, 45cm spacing produced taller plants than all the other spacings.

The weed control treatments had significant effect on plant height in all the trials except at 6 WAS in 1988. In all cases, except at 12 and 6WAS in 1985 and 1986, respectively, the weedy check resulted in significantly taller plants than the other treatments. At 12 WAS in 1985 Galex at 1.5kg a.i/ha alone resulted in shorter plants than all other weed control treatments including the weedy check. In 1986, at 6 WAS soyabean plants in plots treated with Galex at 3.0kg a.i/ha with and without SHW and those hoe-weeded were shorter than those of the weedy check.

At 6 WAS, with and without SHW, no significant differences in plant heights were observed between the two rates of Galex used in all the trials. The hoe-weeded control resulted in plant height similar to all the herbicide treatments in 1984 but taller plants than Galex at 3.0kg a.i/ha followed by SHW in 1985 and 1986.

At 9 WAS, supplementary hoe-weeding of plots treated with Galex at 1.5 and 3.0kg a.i/ha resulted in shorter plants than their corresponding rates alone in all the trials. In 1986 and

1988, the hoe-weeded control resulted in taller plants than those of both rates of Galex followed by SHW but comparable to their rates alone. In 1984 the hoe-weeded control had shorter plants than the herbicide treatments, while in 1985 it had plant height comparable to those of all the other treatments. In the two years SHW resulted in shorter plants than the herbicide application alone.

At 12 WAS in 1985, 1986 and 1988, all the herbicide treatments and the hoe-weeded control except Galex at 1.5kg a.i/ha in 1985, resulted in similar plant height. In 1984 supplementary hoe-weeding resulted in shorter plants compared with the corresponding herbicide rates alone.

Interaction of row spacing and weed control treatments was significant on the plant hight of soyabean at 9 WAS in 1986 (Table 102). Plant height did not differ significantly among the spacings in all the plots given herbicide and hoe-weeding treatments. However, with the weedy check soyabean plants at 45cm spacing were taller than those of the other spacings. The soyabean plants at row spacings of 60 and 75cm had similar height but taller than those of 90cm row spacing.

Table 98: Effect of row spacing and weed control treatments on height of soyabean at Samaru, 1984 wet season.

Treatments	plant height (cm) at 6 WAS[1/]	9 WAS	12WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	26.2a[2/]	67.1a	76.0
60cm x 6.25cm	25.7b	66.5b	75.7
75cm x 5.00cm	25.5bc	66.2b	75.2
90cm x 4.17cm	25.3c	66.0b	74.6
S.E (±)	0.11	0.20	0.44
Weed control treatment (W)			
Galex [5/] at 1.5kg a.i/ha	25.8b	65.2c	75.2b
Galex at 1.5kg a.i/ha fb[6/] SHW [7/] 6 WAS	25.9b	62.0d	69.5d
Galex at 3.0kg a.i/ha	25.9b	65.1c	74.4c
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	25.8b	62.6d	71.9c
Hoe-weeded at 3 and 6 WAS (control)	25.6b	66.9b	73.2bc
Weedy check	27.7a	78.9a	88.0a
S.E. (±)	0.14	0.24	0.71
Interaction I x W	NS	NS	NS

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ Not significant
4/ Not significant.
5/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
6/ Followed by 7/ supplementary hoe-weeding.

Table 99: Effects of row spacing and weed control treatments on height of soyabean at Samaru, 1985 wet season.

Treatments	plant height (cm) at 6 WAS[1/]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	25.3	65.1	76.6a[2/]
60cm x 6.25cm	25.1	64.8	75.0a
75cm x 5.00cm	25.1	64.3	75.3a
90cm x 4.17cm	24.6	64.0	61.9b
S.E (±)	0.23	0.67	0.54
Weed control treatment (W)			
Galex[4/] at 1.5kg a.i/ha	25.4b	63.3b	64.4b
Galex at 1.5kg a.i/ha fb SHW[5/] [6/]			
at 6 WAS	24.7bcd	60.7c	72.7a
Galex at 3.0kg a.i/ha	25.0bcd	63.2b	74.1a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	24.3d	60.5c	73.5a
Hoe-weeded at 3 and 6 WAS. (Control)	25.3bc	62.9bc	74.6a
Weedy check	27.3a	76.8a	74.6a
S.E (±)	0.28	0.82	0.66
Interaction I x W	NS[3/]	NS	NS

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ Not significant
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

Table 100: Effects of row spacing and weed control treatments on height of soyabean at Samaru, 1986 wet season.

Treatments	Plant height (cm) at 6 WAS[1/]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	27.4a[2/]	66.1a	78.5
60cm x 6.25cm	27.0ab	64.0c	78.4
75cm x 5.00cm	26.6ab	65.3b	77.5
90cm x 4.17cm	26.1b	65.0b	77.4
S.E (±)	0.33	0.27	0.75
Weed control treatment (W)			
Galex[5/] at 1.5kg a.i/ha	27.7a	64.3b	77.0b
Galex at 1.5kg a.i/ha fb SHW[6/][7/] at 6 WAS	27.1ab	61.7c	75.8b
Galex at 3.0 a.i/ha	26.3bc	64.5b	76.0b
Galex at 3.0 a.i/ha fb SHW at 6 WAS	25.5c	61.5c	75.4b
Hoe-weeded at 3 and 6 WAS (Control)	26.0b	64.3b	75.7b
Weedy check	28.1a	74.3a	87.0a
S.E. (±)	0.40	0.32	0.91
Interaction			
I x W	NS[4/]	*[3/]	NS

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ significant at 5% level of probability
4/ Not significant
5/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
6/ Followed by 7/ supplementary hoe-weeding.

Table 101: Effects of row spacing and weed control treatments on height of soyabean at Samaru, 1988 wet season.

Treatments	Plant height (cm) at 6 WAS[1/]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	25.6	66.7	79.3
60cm x 6.25cm	25.4	66.7	78.2
75cm x 5.00cm	25.1	66.0	78.1
90cm x 4.17cm	24.9	65.8	77.7
S.E (±)	1.68	0.47	0.79
Weed control treatment (W)			
Galex[4/] at 1.5kg a.i/ha	25.2	65.3b[3/]	78.3b
Galex at 1.5kg a.i/ha fb SHW[6/] at 6 WAS[5/]	24.4	62.7c	75.9bc
Galex at 3.0kg a.i/ha	25.1	65.2b	76.6bc
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	24.5	62.6c	75.4c
Hoe-weeded at 3 and 6 WAS. (Control)	25.0	65.4b	75.9bc
Weedy check	27.6	76.6a	87.7a
S.E. (±)	2.06	0.58	0.97
Interaction			
I x W	NS[2/]	NS	NS

1/ Weeks after sowing
2/ Not significant
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's multiple Range Test (DMRT)
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

Table 102:Interaction of row spacing and weed control on height of soyabean at 9 WAS at Samaru, 1986 wet season.

Weed control treatment	plant height (cm) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	64.8d [2]	64.4d	64.2d	63.9def
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	62.0fg	61.8g	61.6g	61.2g
Galex at 3.0kg a.i/ha	64.8d	64.6d	64.4d	64.0de
Galex at 3.0kg a.i/ha fb SHW 6 WAS	62.1efg	61.6g	61.2g	61.0g
Hoe-weeded at 3 and 6 WAS (Control)	64.5d	64.3d	64.4d	64.0de
Weedy check	78.6a	75.8b	75.7b	67.1c
SE ±		0.65		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

4.2.5 **Crop vigour score**

Crop vigour score of soyabean plants was significantly affected by row spacing at 9 and 12 WAS in 1984, 6,9 and 12 WAS in 1985, at 12 WAS in 1986 and at 6 and 12 WAS in 1988 (Table 103 to 106).

At 6 WAS, in 1985 and 1988 soyabean crop at 90cm spacing had lower crop vigour compared with the other spacing. Similarly at 9 and 12 WAS in 1984 and 1985 and 12 WAS in 1986 and 1988 vigour score of crops planted 45 and 90cm spacings were significantly lower than those of the appropriate maximum at each stage of crop growth and in each year. Similarly, 45 and 90cm row spacing resulted in similar crop vigour in all the trials.

Weed control treatments also had significant effect on crop vigour score of soyabean at 6,9 and 12 WAS in all the trials. In all cases, the crop of the weedy check had significantly lower vigour scores than those of the other weed control treatments.

At 6 WAS plots hoe-weeded twice at 3 and 6 WAS and those sprayed with Galex at 3.0kg a.i/ha had similar crop vigour scores that were significantly higher than those of the plots treated with Galex at 1.5kg a.i/ha in all the trials.

In all years at subsequent stages of crop growth in all the years except at 12 WAS in 1984, the herbicide application at both rates followed by SHW resulted in crop vigour scores comparable to the hoe-weeded control but higher than the

corresponding herbicide rates alone. Without SHW, Galex at 3.0kg a.i/ha caused higher vigour score than the lower rate at 9 WAS in 1984 and 1985. At 12 WAS in 1986, crop vigour score of Galex at 1.5kg a.i/ha with or without SHW was significantly lower than that of corresponding treatment of Galex at 3.0kg a.i/ha and the hoe-weeded control.

The interaction between row spacing and weed control treatment was significant at 12 WAS in 1984 (Table 107). 45cm spacing soyabean had higher crop vigour score than the other spacings when exposed to weed competition throughout the life cycle. No significant differences were observed among the spacings in the other weed control treatments. At 45cm row spacing SHW resulted in higher crop vigour score compared with the herbicide treatments alone at both rates. At 60cm spacing, SHW only improved crop vigour score when it followed application of Galex at 1.5kg a.i/ha. At 45 and 60cm spacing hoe-weeding resulted in higher vigour scores than the herbicide applications alone, while no differences were observed with the other spacings.

Table 103: Effects of row spacing and weed control treatments on the crop vigour score of soyabean at Samaru, 1984 wet season.

Treatments	Crop vigour score [1] at 6 WAS[2]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	7.4	7.9b	8.0c
60cm x 6.25cm	7.3	8.1ab	8.4a
75cm x 5.00cm	7.1	8.2a	8.4ab
90cm x 4.17cm	7.0	7.8b	8.2bc
S.E (±)	0.11	0.10	0.09
Weed control treatment (W)			
Galex [5] at 1.5kg a.i/ha	6.9b [4]	7.4c	8.3b
Galex at 1.6kg a.i/ha fb [6] SHW [7] at 6 WAS	7.2b	8.8a	8.4ab
Galex at 3.0kg a.i/ha	7.8a	7.9b	8.3b
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	7.8a	8.7a	8.9a
Hoe-weeded at 3 and 6 WAS (Control)	7.9a	8.8a	8.9a
Weedy check	5.7c	6.4d	6.7c
S.E. (±)	0.13	0.12	0.11
Interaction			
I x W	NS [3]	NS	* [8]

1/ Based on zero-to-ten scale where "0" is for dead plants and 10 for most vigorous plants.
2/ Weeks after sowing
3/ Not significant
4/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
5/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
6/ Followed by 7/ Supplementary hoe-weeding. 8/ significant at 5% level of probability

Table 104: Effects of row spacing and weed control treatment on the crop vigour score of soyabean at Samaru, 1985 wet season.

Treatments	Crop vigour score 1/ at 6 WAS 2/	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
	4/		
45cm x 8.33cm	7.7a	7.9b	8.5bc
60cm x 6.25cm	7.5a	8.1ab	8.7ab
75cm x 5.00cm	7.4a	8.4a	8.8a
90cm x 4.17cm	6.9b	7.9b	8.3c
S.E (±)	0.14	0.10	0.09
Weed control treatment (W)			
Galex 5/ at 1.5kg a.i/ha	7.5b	7.4c	8.2b
Galex at 1.5kg a.i/ha fb 6/ SHW 7/ at 6 WAS	7.4b	8.7a	9.1a
Galex at 3.0kg a.i/ha	7.9a	7.9b	8.5b
Galex at 3.0kg a.i/ha fb SHW at 6 WAS.	7.9a	9.0a	9.4a
Hoe-weeded at 3 and 6 WAS (Control)	8.1a	8.9a	9.3a
Weedy check	6.08c	6.5d	7.0c
S.E. (±)	0.17	0.13	0.12
Interaction			
I x W	3/ NS	NS	NS

1/ Based on zoro-to-ten scale where "0" is for dead plants and 10 for most vigorous plants.
2/ Weeks after sowing
3/ Not significant
4/ Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
5/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
6/ Followed by 7/ supplementary hoe-weeding.

Table 105: Effects of row spacing and weed control treatment on the crop vigour score of soyabean at Samaru. 1986 wet season.

Treatments	Crop vigour score 1/ at 6 WAS	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
			4/
45cm x 8.33cm	7.5	8.3	8.6bc
60cm x 6.25cm	7.5	8.2	8.7ab
75cm x 5.00cm	7.4	8.1	8.8a
90cm x 4.17cm	7.3	8.0	8.5c
S.E (±)	0.10	0.09	0.07
Weed control treatment (I)			
5/ Galex at 1.5kg a.i/ha	7.2b	7.9b	8.2d
6/ Galex at 1.5kg a.i/ha fb 7/ SHW at 6 WAS	7.4b	8.8a	9.1b
Galex at 3.0kg a.i/ha	7.9a	8.2b	8.5c
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	8.0a	8.7a	9.5a
Hoe-weeded at 3 and 6 WAS (Control)	7.9a	8.7a	9.4a
Weedy check	6.4c	6.7c	7.0e
S.E. (±)	0.12	0.11	0.09
Interaction			
I x W	3/ NS	NS	NS

1/ Based on zero-to-ten scale where "0" is for dead plants and 10 for most vigorous plants.
2/ Weeks after sowing
3/ Not significant
4/ Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
5/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
6/ Followed by 7/ supplementary hoe-weeding.

Table 106: Effects of row spacing and weed control treatment on the crop vigour score of soyabean at Samaru, 1988 wet season.

Treatments	Crop vigour score [1] at 6WAS[2]	9WAS	12WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	8.0a [4]	8.5	8.6bc
60cm x 6.25cm	8.10a	8.3	8.8b
75cm x 5.00cm	8.1a	8.2	9.6a
90cm x 4.17cm	7.7b	8.1	8.4c
S.E (±)	0.11	0.71	0.07
Weed control treatment (W)			
Galex [5] at 1.5kg a.i/ha	7.8b	8.0b	8.7b
Galex at 1.5kg a.i/ha fb [6] SHW [7] at 6 WAS	8.0b	8.8a	9.2a
Galex at 3.0kg a.i/ha	8.5a	8.3b	8.9b
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	8.6a	8.8a	9.2a
Hoe-weeded at 3 and 6 WAS (Control)	8.6a	8.8a	9.3a
weedy check	6.4c	6.9c	7.1c
S.E. (±)	0.13	0.14	0.08
Interaction			
I x W	NS [3]	NS	NS

1/ Based on zero-to-ten scale where "0" is for dead plants and 10 for most vigorous plants.
2/ Weeks after sowing
3/ Not significant
4/ Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level probability using the Duncan's Multiple Range Test (DMRT)
5/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
6/ Followed by 7/ supplementary hoe-weeding.

Table 107: Interaction of row spacing and weed control treatment on the crop vigour score of soyabean at 12 WAS at Samaru, 1984 wet season.

Weed control treatment	Crop vigour score 1/ Row spacing (cm) 45	60	75	90
Galex 2/ at 1.5kg a.i/ha	8.0d 3/	8.3bcd	8.6a-d	8.3bcd
Galex at 1.5kg a.i/ha fb SHW 5/ 6 WAS 6/	8.9abc	9.0a	9.0ab	8.8abc
Galex at 3.0kg a.i/ha	8.0d	8.2cd	8.3bcd	8.5a-d
Galex at 3.0kg a.i/ha fb SHW 6 WAS	9.1a	8.9abc	9.0ab	8.7a-d
Hoe-weeded at 3 and 6 WAS (Control)	8.8abc	9.1a	8.9abc	8.9abc
Weedy check	7.0e	6.8f	6.5f	6.3f
S.E (±)		0.23		

1. Based on zero-to-ten scale where 0 is for dead plants and 10 for most vigorously growing plants.
2. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
3. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
4. Followed by
5. Supplementary hoe-weeding
6. Weeks after sowing
7. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

4.2.6 **Percent ground cover**

Both the row spacings and weed control treatments had significant effects on percent ground cover in all the trials (Tables 108 to 111).

The percentage ground cover of soyabean decreased significantly with spacing except at 12 WAS in 1985 and 1986. The ground cover of soyabean was similar for 60 and 75cm spacing in 1985 and 75 and 90cm spacing in 1986. In both situations, 45cm caused higher ground cover while 90cm spacing also resulted in significantly lower soyabean ground cover.

The weedy check resulted in significantly lower ground cover than all the weed control treatments in all the trials. Significant differences among other weed control treatments were however only observed at 6 and 9 WAS in all the trials.

In 1985 and 1988 significantly lower ground cover of soyabean at 6 WAS was observed with Galex at 1.5kga.i/ha compared with the hoe-weeded control. However, in 1986, Galex at 1.5kga.i/ha caused lower ground cover of soyabean at 6 WAS than the corresponding high rate of the herbicide at 6WAS. SHW increased ground cover at 9 WAS when it followed Galex at 3.0kg a.i/ha in 1984, 1986 and 1988 and Galex at 1.5kg a.i/ha in 1985 compared with the herbicide application alone. Ground cover of herbicide treated plots given SHW were comparable to those of the hoe-weeded control in 1984 and 1985 while only Galex at 3.0kg a.i/ha had ground cover comparable to the hoe-weeded control when given SHW in 1986. In 1986, ground cover

with Galex at 1.5kg a.i/ha with and without SHW did not differ significantly from the hoe-weeded control.

The interaction of row spacing and weed control on ground cover of soyabean was significant at all sampling stages in all trials (Table 112 to 123).

At 6 WAS in 1984 (Table 112) Galex at 1.5kga.i/ha with and without SHW at 60cm spacing, Galex at 1.5kga.i/ha fb SHW and Galex at 3.0kga.i/ha alone at 90cm spacing as well as all the hebicide treatments at 75cm spacing resulted in lower soyabean cover than the two hoe-weedings in the trials. Ground cover with the weedy check was lower than those of all the other weed control treatments at all spacings.

In 1985 (Table 113) ground cover of soyabean decreased significantly with increase in spacing on the plots sprayed with Galex at 1.5 and 3.0 kg a.i/ha without SHW and those hoe-weeded twice at 3 and 6 WAS. However in plots given SHW soyabean ground cover increased with increase in row spacing from 60cm, while it increased from 45 to 75cm on those kept weedy throughout. Although only Galex at 3.0kga.i/ha fb SHW caused higher ground cover than the how-weeded check at 60cm spacing, all the herbicide treatments caused higher cover at 75cm row spacing. In the weedy check, the ground cover at 75 and 90cm row spacings were similar and significantly lower than those of 45 and 60cm.

In 1986 (Table 114) all the herbicide treatments and the weedy check caused significant decrease in ground cover with

increase in row spacing from 45cm. In the hoe-weeded control soyabean at 45 and 60cm spacings had similar ground cover which was higher than that of soyabean in rows spaced 75 and 90cm apart. At row spacings of 60 and 75cm, ground cover of soyabean treated with Galex at 1.5kg a.i/ha was lower than that followed by SHW while their ground cover was comparable at 90cm spacing. Although no difference was observed between the two treatments of Galex at 3.0kg a.i/ha at 75cm spacing, SHW of the herbicide rate resulted in significantly lower soyabean ground cover at 60 and 90cm spacings. Hoe-weeding twice resulted in significantly higher soyabean cover than all the herbicide treatments except Galex at 1.5kg a.i/ha fb SHW at 60cm spacing but lower than Galex at 1.5kga.i/ha fb SHW at 75cm spacing and all the herbicide treatments at 90cm spacing.

In 1988, (Table 115) with the herbicide treatments and the hoe-weeded control each increase in row spacing resulted in a significant decrease in ground cover. However, with the weedy check, soyabean ground cover did not decrease beyond 75cm row spacing. At 45cm rows spacing, soyabean in the weedy check had similar ground cover to that of the other treatments while the weedy check had lower ground cover in the other row spacings. At 60, 75 and 90cm row spacings soyabean treated with Galex at 3.0kg a.i/ha alone had higher ground cover than the corresponding low rate. Similarly, at 75cm spacing soyabean treated with Galex at 1.5kg a.i/ha fb SHW had lower ground cover than the corresponding high rate. The soyabean

hoe-weeded at 3 and 6 WAS gave lower ground cover than that treated with Galex at 3.0kg a.i/ha at 60cm spacing and all the herbicide treatments at 75cm spacing.

At 9 WAS in 1984, (Table 116) ground cover of soyabean in plots treated with Galex at 1.5kg a.i/ha alone and that of the hoe-weeded control increased with decreasing row spacing up to 60cm spacing had lower cover than the other herbicide treatments the crop at 90cm spacing had lower cover than the other spacings which were similar. Row spacing at 45cm produced the highest ground cover while the lowest was produced by 90cm. At 45 and 60cm spacings no difference were observed in ground cover among the herbicide and hoe-weeded treatments. However, at 75cm spacing, Galex at 1.5kg a.i/ha alone and the hoe-weeded control caused lower cover than the other herbicide treatments. At 90cm spacing, with the exception of Galex at 3.0kg a.i/ha fb SHW, the herbicide treatments resulted in lower ground cover than the hoe-weeded control.

In 1985 (Table 117) the ground cover of all the soyabean, of the plots with the weed control treatments except Galex at 1.5 kg a.i/ha fb SHW and the weedy check increased with decreasing row spacing up to 60cm row spacing. In the weedy check, the ground cover increased significantly with decreasing row spacing to 45cm. With the application of Galex at 1.5kg a.i/ha fb SHW, row spacings of 45, 60, and 75cm produced similar soyabean ground covers which were

significantly higher than that of the crop at 90cm spacing. With the application of Galex at 1.5kg a.i/ha alone and 3.0kg a.i/ha with and without SHW, soyabean ground cover at 45 and 60cm row spacing was similar but higher than at 75 and 90cm row spacing. Ground cover score with the weedy check was lower than those of the other weed control treatments at 60, 75 and 90cm spacing. Galex at 1.5kg a.i/ha fb SHW caused higher soyabean ground cover than Galex at 1.5kg a.i/ha alone and the hoe-weeded control at 75cm row spacing, while at 90cm spacing the hoe-weeded control had higher soyabean ground cover than the herbicides without SHW.

In 1986 and 1988, at 9 WAS (Table 118 to 119) soyabean treated with Galex at 1.5kg a.i/ha with and without SHW and Galex at 3.0kg a.i/ha alone had significantly lower ground cover at 90cm spacing compared with the soyabean ground cover at 45, 60, and 75cm spacing. No significant differences in ground cover were observed among the row spacings with Galex at 3.0kg a.i/ha fb SHW and the hoe weeded control. However, with the weedy check soyabean ground cover decreased significantly with increase in row spacing. At 45cm row spacing, ground cover of soyabean in all the weed control treatments were similar, while at 60,75 and 90cm row spacings ground cover of soyabean in the weedy check was lower than those of the other treatments. In 1986 at 90cm row spacing, plots treated with Galex at 3.0kg a.i/ha fb SHW and those hoe-weeded twice had higher soyabean ground cover than those of

the other herbicide treatments.

In 1988, at 90cm row spacing soyabean hoe-weeded at 3 and 6 WAS had higher ground cover than those of the other herbicide treatments. At the spacing, while SHW resulted in ground cover depression when it followed Galex at 1.5kg a.i/ha it improved ground cover after Galex at 3.0kg a.i/ha.

At 12 WAS in 1984 to 1988 (Tables 120 to 123) all the herbicide treatments and the hoe-weeded control had similar ground cover at all the row spacings. However, with the weedy check, each increase in row spacing caused a significant decrease in soyabean ground cover. Except at 45cm row spacing when soyabean ground covers for all the treatments were similar, soyabean left unweeded throughout the crop life cycle had a lower ground cover than that which received the other treatments at the 60,75 and 90cm row spacings.

Table 108: Effects of row spacing and weed control treatments on percent ground cover of soyabean at Samaru, 1984 wet season.

Treatments	% ground cover at 6 WAS[1/]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	99.2a[2/]	99.6a	100.0a
60cm x 6.25cm	93.0b	97.5b	99.4b
75cm x 5.00cm	81.2c	96.5c	98.1c
90cm x 4.17cm	67.3d	84.4d	96.7d
S.E (±)	0.28	0.21	0.14
Weed control treatment (I)			
Galex[4/] at 1.5kg a.i/ha	87.2ab	94.9b	100.0a
Galex at 1.5kg a.i/ha fb[5/] SHW[6/] at 6 WAS	86.7ab	96.6ab	100.0a
Galex at 3.0kg a.i/ha	87.0ab	96.3b	100.0a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	86.2b	97.1a	100.0a
Hoe-weeded at 3 and 6 WAS (Control)	87.6a	96.5ab	100.0a
Weedy check	77.1c	86.0d	91.4b
S.E. (±)	0.34	0.25	0.17
Interaction			
I x W	*[3/]	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ significant at 5% level of probability
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

Table 109: Effects of row spacing and weed control tretments on percent ground cover of soyabean at Samaru, 1985 wet season.

Treatments	% ground cover at 6 WAS[1/]	9WAS	12WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	100.0a[2/]	100.0a	100.0a
60cm x 6.25cm	94.4b	98.2b	97.3b
75cm x 5.00cm	78.8c	91.4c	97.6b
90cm x 4.17cm	73.4d	72.8d	95.6c
S.E (±)	0.33	0.48	0.13
Weed control treatment (I)			
Galex[4/] at 1.5kg a.i/ha	86.9c	90.9b	100.0a
Galex at 1.5kg a.i/ha fb[5/] SHW[6/] at 6 WAS	88.0bc	92.8a	100.0a
Galex at 3.0kg a.i/ha	89.6ab	92.5a	100.0a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	89.1ab	91.5ab	100.0a
Hoe-weeded at 3 and 6 WAS (Control)	89.8a	92.5a	100.0a
Weedy check	78.7d	83.4c	88.7b
S.E (±)	0.41	0.58	0.16
Interaction			
I x W	*[3/]	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ significant at 5% level of probability
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

Table 110: Effects of row spacing and weed control treatments on percent ground cover of soyabean at Samaru, 1986 wet season.

Treatments	% ground cover at 6 WAS[1/]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	99.5a[2/]	100.0a	100.0a
60cm x 6.25cm	94.4b	98.4b	99.8a
75cm x 5.00cm	85.0c	97.6c	98.4b
90cm x 4.17cm	75.6d	95.9d	98.1b
S.E (±)	0.31	0.17	0.13
weed control treatment (W)			
Galex[4/] at 1.5kg a.i/ha	90.0b	99.6b	100.0a
Galex at 1.5kg a.i/ha fb[5/] SHW[6/] at 6 WAS	90.6b	99.5b	100.0a
Galex at 3.0kg a.i/ha	91.3a	99.3b	100.0a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	91.7a	100.0a	100.0a
Hoe-weeded at 3 and 6 WAS (Control)	89.0bc	100.0	100.0a
Weedy check	78.9d	89.6c	94.3b
S.E (±)	0.38	0.21	0.17
Interaction			
I x W	*[3/]	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ Significant at 5% level of probability
4/ Proprietory mixture of metolachlor plus metobromuron in 1.1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

Table 111: Effects of row spacing and weed control treatments on percent ground cover of soyabean at Samaru, 1988 wet season.

Treatments	% ground cover at 6 WAS[1]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	100.0a[2]	100.0a	100.0a
60cm x 6.25cm	90.2b	97.3b	99.2b
75cm x 5.00cm	83.1c	96.8c	98.6c
90cm x 4.17cm	70.4d	91.0d	98.3d
S.E (±)	0.24	0.11	0.06
Weed control treatment (W)			
Galex at 1.5kg a.i/ha [4]	86.3c	98.8ab	100.0a
Galex at 1.5kg a.i/ha fb [5] SHW [6] at 6 WAS	86.9bc	98.8ab	100.0a
Galex at 3.0kg a.i/ha	87.4ab	97.7c	100.0a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	87.3ab	98.5b	100.0a
Hoe-weeded at 3 and 6 WAS (Control)	87.9a	99.1a	100.0a
Weedy check	77.0e	85.4d	94.1b
S.E (±)	0.29	0.13	0.07
Interaction			
I x W	*[3]	*	*

1/ Weeks after sowing
2/ Means followed by the same letter(s) within the same colum are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ Significant at 5% level of probability
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

Table 112: Interaction of row spacing and weed control treatments on per cent ground cover of soyabean at 6 WAS at Samaru, 1984 wet season.

Weed control treatment	% ground cover Row spacings (cm) 45	60	75	90
Galex [1] at 1.5 a.i/ha	100.0a [2]	93.5cd	83.7f	70.5hi
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	100.0a	93.1d	82.1fg	71.5h
Galex at 3.0kg a.i/ha	100.0a	95.5bcd	82.3fg	70.5gh
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	95.3bc	81.0g	70.7hi
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	95.6b	85.8e	69.0i
Weedy check	95.0bcd	83.7e	72.2h	57.6j
S.E (±)		0.68		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 113: Interaction of row spacing and weed control treatments on percent ground cover of soyabean at 6 WAS at Samaru, 1985 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	100.0a [2]	95.5c	78.6f	73.4g
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	100.0a	78.8sbc	78.1f	74.0g
Galex at 3.0kg a.i/ha	100.0a	97.5bc	80.5f	74.5g
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	98.9ab	80.1f	75.3g
Hoe-weeded at 3 and 6 WAS (control)	100.0a	95.6c	89.0d	74.6g
Weedy check	100.0a	83.1e	66.7h	64.8h
S.E (±)		0.82		

1. Proprietory mixture of metolachlor plus metobromuron in 1:.1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 114: Interaction of row spacing and weed control treatment on percent ground cover of soyabean at 6 WAS at Samaru, 1986 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex[1] at 1.5kg a.i/ha	100.0a[2]	94.3de	86.7g	79.0h
Galex at 1.5kg a.i/ha fb[3] SHW[4] 6 WAS[5]	100.0a	96.8bc	89.8f	78.7h
Galex at 3.0kg a.i/ha	100.0a	96.2cd	87.5g	76.4i
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	93.6e	87.1g	73.4j
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	98.8ab	86.3g	70.6k
Weedy check	97.2bc	86.5g	72.5jk	63.5l
S.E (±)		0.76		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 115: Interaction of row spacing and weed control treatments on percent ground cover of yoyabean at 6 WAS at Samaru, 1988 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	100.0a [2]	92.3cd	80.4g	71.6j
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	100.0a	93.4cd	80.2g	71.1j
Galex at 3.0kg a.i/ha	100.0a	96.6b	84.4f	72.5i
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	95.8bc	83.7f	70.8j
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	91.2d	88.9e	71.6j
Weedy check	100.0a	75.9h	70.8k	61k
S.E (±)		0.58		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 116: Interaction of row spacing and weed control treatments on percent ground cover of soyabean at 9 WAS at Samaru, 1984 wet season.

Weed control treatment	% ground cover Row scpacing (cm) 45	60	75	90
Galex[1/] at 1.5kg a.i/ha	100.0a[2/]	100.0a	97.5b	82.0f
Galex at 1.5kg a.i/ha fb[3/] SHW[4/] 6 WAS[5/]	100.0a	100.0a	100.0a	86.2de
Galex at 3.0kg a.i/ha	100.0a	100.0a	100.0a	85.3de
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	100.0a	100.0a	88.3c
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	100.0a	96.2b	89.7c
Weedy check	97.5b	84.8e	86.5d	75.2g
S.E (±)		0.51		

1. proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 117: Interaction of row spacing and weed control treatments on percent ground cover of soyabean at 9 WAS at Samaru, 1985 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	100.0a [2]	100.0c	90.7de	72.9g
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	100.0a	100.0a	97.1ab	74.1fg
Galex at 3.0kg a.i/ha	100.0a	100.0a	95.8bc	70.7g
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	100.0a	95.3bc	74.1fg
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	100.0a	93.3cd	76.6f
Weedy check	100.0a	88.9e	76.4f	68.4h
S.E (±)		1.17		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 118: Interaction of row spacing and weed control treatments on percent ground cover of soyabean at 9 WAS at Samaru, 1986 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex[1] at 1.5kg a.i/ha	100.0a[2]	100.00a	100.0a	98.3b
GAlex at 1.5kg a.i/ha fb[3] SHW[4] 6 WAS[5]	100.0a	100.0a	100.0a	97.8b
Galex at 3.0kg a.i/ha	100.0a	100.0a	100.0a	97.1b
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	100.0a	100.0a	100.0a
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	100.0a	100.0a	100.0a
Weedy check	100.0a	90.4c	85.5d	82.3e
S.E (±)		0.42		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 119: Interaction of row spacing and weed control treatments on percent ground cover of soyabean at 9 WAS at Samaru, 1988 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	100.0a	100.0a	100.0a	95.1c
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	100.0a	100.0a	100.0a	93.0e
Galex at 3.0kg a.i/ha	100.0a	100.0a	100.0a	90.7f
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	100.0a	100.0a	93.9d
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	100.0a	100.0a	96.4b
Weedy check	100.0a	83.6g	80.9h	77.0i
S.E (±)		0.27		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 120: Interaction of row spacing and weed control treatments on percent ground cover of soyabean at 12 WAS at Samaru, 1984 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex[1] at 1.5kg a.i/ha	100.0a[2]	100.0a	100.0a	100.0a
Galex at 1.5kg a.i/ha fb[3] SHW[4] 6 WAS[5]	100.0a	100.0a	100.0a	100.0a
Galex at 3.0kg a.i/ha	100.0a	100.0a	100.0	100.0a
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	100.0a	100.0a	100.0a
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	100.0a	100.0a	100.0a
Weedy check	100.0a	96.5b	88.6c	80.4d
S.E (±)		0.331		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 121: Interaction of row spacing and weed control treatments on percent ground cover of soyabean at 12 WAS at Samaru, 1985 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex[1] at 1.5kg a.i/ha	100.0a[2]	100.0a	100.0a	100.0a
Galex at 1.5kg a.i/ha fb[3] SHW[4] 6 WAS[5]	100.0a	100.0a	100.0a	100.0a
Galex at 3.0kg a.i/ha	100.0a	100.0a	100.0	100.0a
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	100.0a	100.0a	100.0a
Hoe-weeded at 3 and 6 WAS (*Control*)	100.0a	100.0a	100.0a	100.0a
Weedy check	100.0a	95.5b	85.6c	73.5d
S.E (±)		0.33		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 122: Interaction of row spacing and weed control treatments on percent ground cover of soyabean at 12 WAS at Samaru, 1986 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex[1] at 1.5kg a.i/ha	100.0a[2]	100.0a	100.0a	100.0a
Galex at 1.5kg a.i/ha fb[3] SHW[4] 6 WAS[5]	100.0a	100.0a	100.0a	100.0a
Galex at 3.0kg a.i/ha	100.0a	100.0a	100.0a	100.0a
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	100.0a	100.0a	100.0a
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	100.0a	100.0a	100.0a
Weedy check	100.0a	95.5b	85.6c	73.3d
S.E (±)		0.33		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 123: Interaction of row spacing and weed control treatments on percent ground cover of soyabean at 12 WAS at Samaru, 1988 wet season.

Weed control treatment	% ground cover Row spacing (cm) 45	60	75	90
Galex[1] at 1.5kg a.i/ha	100.0a[2]	100.0a	100.0a	100.0a
Galex at 1.5kg a.i/ha fb[3] SHW[4] 6 WAS[5]	100.0a	100.0a	100.0a	100.0a
Galex at 3.0kg a.i/ha	100.0a	100.0a	100.0a	100.0a
Galex at 3.0kg a.i/ha fb SHW 6 WAS	100.0a	100.0a	100.0a	100.0a
Hoe-weeded at 3 and 6 WAS (Control)	100.0a	100.0a	100.0a	100.0a
Weedy check	100.0a	98.6b	90.2c	88.4d
S.E (±)		0.330		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

4.2.7 Number of branches per plant

Row spacing had no significant effect on number of branches of soyabean in all the trials while weed control treatments significantly influenced number of branches of soyabean.(Tabes 124 - 127). The interaction of row spacing and weed control tretments on the number the of branches per plant at 6 and 9 WAS in 1985 and 1986, respectively, was also significant (Tables 128 to 129).

In all the trials the weedy check resulted in significantly lower number of branches than all the other treatments. Except at 6 WAS in 1984, the hoe-weeded control did not differ significantly from all the herbicide treatments in the number of branches. In 1984 Galex at 1.5kg a.i/ha alone resulted in significantly lower number of branches per plant of soyabean at 6 WAS than the hoe-weeded control. In 1988, Galex at 3.0kg a.i/ha fb SHW gave higher number of branches than Galex at 1.5kg a.i/ha at 9 WAS and Galex at 1.5kg a.i/ha fb SHW at 12 WAS (Table 127).

The interaction of row spacing and weed control treatments at 6 WAS in 1985 (Table 128) showed that with the application of Galex at 1.5kg a.i/ha with and without SHW and Galex at 3.0kg a.i/ha alone the number of soyabean branches increased with row spacing up to 75cm however, with Galex at 3.0kg a.i/ha fb SHW number of branches increased with row spacing up to 90cm. Soyabean hoe-weeded at 3 and 6 WAS had the highest number of branches at 90cm row spacing and this decreased with row spacing up to 60cm. Number of branches of

soyabean at 45 and 60cm row spacings were similar but lower than that at 75cm spacing. When kept weedy soyabean crop planted at 60,75 and 90cm row spacing produced similar number of branches which were higher than that at 45cm row spacing. The soyabean kept weedy caused the production of lower number of branches compared with the other weed control treatments at all soyabean crop spacings. Galex at 3.0kga.i/ha fb SHW and the hoe-weeded control also caused the production of more branches than the other weed control treatments at 90cm row spacing while at the spacing hoe-weeding resulted in the highest number of branches in the trial.

The interaction at 9 WAS in 1986 (Table 129) showed that with Galex at 1.5kg a.i/ha with and without SHW and Galex at 3.0kg a.i/ha alone soyabean at 75 and 90cm row spacings produced similar number of branches that were higher than that at 45cm. With the application of the treatments, the number of branches of soyabean at 45cm row spacing was similar to that at 60cm row spacing. With Galex at 3.0kga.i/ha fb SHW however, only the soyabean planted at 90cm row spacing had higher number of branches than those at 45 and 60cm row spacings. With the herbicide application, soyabean at 45, 60 and 75cm row spacings had similar number of branches in the herbicide treatments. In both the hoe-weeded control and the weedy check soyabean at 90cm row spacing produced higher number of branches than that at 45cm row spacing. While soyabean spaced at 45, 60 and 75cm row spacing had similar number of branches on the plots hoe-weeded at 3 and 6 WAS, in the weedy check

however, similar number of branches were observed in soyabean spaced 60 and 75cm apart on one hand and that at 60 and 45cm row spacing on the other.

Table 124: Effects of row spacing and weed control treatments on number of branches per plant of soyabean at Samaru, 1984 wet season.

Treatments	Number of branches per plant at 6 WAS[1]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	5.9	7.8	8.5
60cm x 6.25cm	5.8	7.9	8.6
75cm x 5.00cm	5.9	7.5	8.5
90cm x 4.17cm	5.0	7.5	8.5
S.E (±)	0.07	0.08	0.09
Weed control treatment (W)			
Galex[4] at 1.5kg a.i/ha	5.6c[3]	7.3a	8.4a
Galex at 1.5kg a.i/ha fb[5] SHW[6] at 6 WAS	5.8bc	7.3a	8.5a
Galex at 3.0kg a.i/ha	5.8ab	7.3a	8.4a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	6.0ab	7.5a	8.5a
Hoe-weeded at 3 and 6 WAS (Control)	6.1a	7.5a	8.3a
Weedy check	4.8d	6.3b	6.8b
S.E. (±)	0.08	0.10	0.11
Interaction			
I x W	NS[2]	NS	NS

1/ Weeks after sowing
2/ Not significant
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

Table 124: Effects of row spacing and weed control treatments on number of branches per plant of soyabean at Samaru, 1985 wet season.

Treatments	Number of branches per plant at 6 WAS[1]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	6.3	7.4	8.5
60cm x 6.25cm	6.5	7.4	8.0
75cm x 5.00cm	6.4	7.5	8.4
90cm x 4.17cm	6.3	7.5	8.3
S.E (±)	0.10	0.09	0.09
Weed control treatment (W)			
Galex[4] at 1.5kg a.i/ha	5.8b[3]	7.4a	8.3a
Galex at 1.5 a.i/ha fb SHW[5] at 6 WAS[6]	6.0ab	7.4a	8.4a
Galex at 3.0kg a.i/ha	5.9ab	7.6a	8.3a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	6.3a	7.4a	8.6a
Hoe-weeded at 3 and 6 WAS (Control)	6.2ab	7.5a	8.5a
Weedy check	4.4c	6.1b	7.1b
S.E (±)	0.12	0.14	0.11
Interaction			
I x W	*[2]	NS[7]	NS

1/ Weeks after sowing
2/ Significant at 5% level of probability
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Propietory mixture of metolachlor plus metobromuron in 1:1 ratio
5/ Followed by 6/ supplementary hoe-weeding. 7/ Not significant.

Table 126: Effects of row spacing and weed control treatments on number of branches per plant of soyabean at Samaru, 1986 wet season.

Treatments	Number of branches per plant at 6 WAS[1/]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	5.1	7.6	7.8
60cm x 6.25cm	5.2	7.7	7.9
75cm x 5.00cm	5.1	7.8	8.8
90cm x 4.17cm	5.0	7.8	8.8
S.E (±)	0.08	0.11	0.11
	2/		
Weed control treatment (W)			
	4/ 3/		
Galex at 1.5kg a.i/ha	5.2a	7.1a	8.3a
	5/		
Galex at 1.5kg a.i/ha fb 6/ SHW at 6 WAS	5.1a	7.3a	8.4a
Galex at 3.0kg a.i/ha	5.2a	7.4a	8.3a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	5.3a	7.4a	8.3a
Hoe-weeded at 3 and 6 WAS (Control)	5.3a	7.5a	8.6a
Weedy check	4.5b	6.2b	6.8b
S.E (±)	0.10	0.1	0.14
Interaction			
	7/	2/	
I x W	NS	*	NS

1/ Weeks after sowing
2/ Significant at 5% level of probability
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Proprietory mixture of metolachlor plus metobromuron in 1.1 ratio.
5/ Followed by 6/ supplementary hoe-weeding. 7/ Not significant

Table 127: Effects of row spacing and weed control treatments on number of branches per plant of soyabean at Samaru, 1988 wet season.

Treatments	Number of branches per plant at 6 WAS[1]	9 WAS	12 WAS
Inter-row and Intra-row spacings (I)			
45cm x 8.33cm	5.4	7.3	8.5
60cm x 6.25cm	5.3	7.4	8.9
75cm x 5.00cm	5.4	7.5	8.3
90cm x 4.17cm	5.4	7.3	8.3
S.E (±)	0.01	0.09	0.09
Significance	NS[2]	NS	NS
Weed control treatment (W)			
Galex[4] at 1.5kg a.i/ha	5.6a[3]	7.2ab	8.3b
Galex at 1.5kg a.i/ha fb SHW[6] at 6 WAS[5]	5.8a	7.1b	8.4ab
Galex at 3.0kg a.i/ha	5.5a	7.3ab	8.4ab
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	5.6a	7.5a	8.6a
Hoe-weeded at 3 and 6 WAS (Control)	5.6a	7.4ab	8.4ab
Weedy check	4.6b	6.5c	6.8c
S.E (±)	0.12	0.11	0.11
Interaction			
I x W	NS[2]	NS	NS

1/ Weeks after sowing
2/ Not significant
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding. 7/ Significant at 5% level of probability

Table 128: Interaction of row spacing and weed control treatments on number of branches per plant of soyabean at 6 WAS at Samaru, 1985 wet season.

Weed control treatment	Number of branches per plant Row scpacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	4.8g [2]	5.5ef	6.3cd	6.5c
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	5.0fg	5.8de	6.5c	6.8c
Galex at 3.0kg a.i/ha	5.0fg	5.8de	6.3cd	6.8c
Galex at 3.0kg a.i/ha fb SHW 6 WAS	4.8g	5.8de	6.5c	8.5a
Hoe-weeded at 3 and 6 WAS (Control)	5.0fg	5.5ef	6.5c	7.8b
Weedy check	3.5h	4.5g	4.5g	5.0fg
S.E (±)	0.24			

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not signigicantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 129: Interaction of row spacing and weed control treatments on number of branches per plant of soyabean at 9 WAS at Samaru, 1986 wet season.

Weed control treatment	Number of branches per plant Row spacing (cm) 45	60	75	90
Galex[1] at 1.5kg a.i/ha	6.3fgh[2]	7.0c-f	7.5a-d	7.8abc
Galex at 1.5kg a.i/ha fb[3] SHW[4] 6 WAS[5]	6.5efg	7.3b-e	7.5a-d	8.0ab
Galex at 3.0kg a.i/ha	6.5efg	7.3b-e	7.8abc	8.0ab
Galex at 3.0kg a.i/ha fb SHW 6 WAS	6.8d-g	7.0c-f	7.5a-d	8.3a
Hoe-weeded at 3 and 6 WAS (Control)	7.0c.f	7.5a-d	7.5a-d	8.0ab
Weedy check	5.5h	6.0gh	6.8d-g	6.5efg
S.E (±)		0.27		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment at not singnificantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

4.2.8 Number of pods per plant

The number of pods of soyabean per plant was significantly affected by the weed control treatments in all the trials (Table 130). All the herbicide treatments and the hoe-weeded check resulted in significantly higher number of pods per plant than the weedy check. In all the trials each plot treated with herbicides fb SHW produced number of pods comparable to that of the hoe-weeded control and significantly higher than the corresponding herbicide treatment alone. In 1986 and 1988 Galex at 3.0kg a.i/ha alone resulted in higher pod number per plant than the corresponding treatment at 1.5kg a.i/ha.

The interactions of row spacing and weed control treatments on the number of soyabean per plant was significant in 1984, 1986 and 1988 (Tables 131 - 133). In 1984,(Table 131) with the application of Galex at 1.5kg a.i/ha alone soyabean at 45, 60 and 75cm row spacing had similar number of pods per plant but higher than that at 90cm row spacing. (Table 131) However, when the herbicide treatment was supplemented with a hoe-weeding, similar number of pods per plant at 60, and 75cm row spacing higher than those obtained at 45cm and 90cm row spacings were obtained. With Galex at 3.0kg a.i/ha, soyabean at 45cm row spacing produced higher pod number than that at 75 and 90cm row spacing, while that at 60 and 75cm had comparable pod number which were higher than that in 90cm row spacing. However, when the herbicide rate was followed by SHW no differences in pod number were observed. With two hoe-

weedings, pod number at 60, 75 and 90cm spacings were similar and higher than that at 45cm spacing. In the weedy check, however, soyabean pod number per plant decreased with increase in row spacing up to 75cm row spacing. At 45cm row spacing soyabean treated with Galex at 3.0kg a.i/ha fb SHW produced a higher number of pods than all the other weed control treatments including the hoe-weeded control. Similarly, at the spacing, plots hoe-weeded twice and those given supplementary hoe-weeding produced higher number of pods than the herbicide at 1.5kg a.i/ha. At the other spacings, plots hoe-weeded twice and herbicide treatments supplemented with hoe-weeding produced higher pod number than those treated with herbicide alone and the weedy check.

In 1986 (Table 132) pod number of soyabean increased with decreasing row spacing up to 60cm when Galex at 1.5kg a.i/ha was applied alone. However, when the same rate of herbicide was followed by SHW and two hoe-weedings at 3 and 6 WAS soyabean pod number increased with row spacing increase from 75 to 90cm. In plots treated with Galex at 3.0kg a.i/ha alone soyabean spaced 45 and 60cm produced more pods than that spaced 90cm but comparable to that at 60 and 75cm row spacings. However, with Galex at 3.0kg a.i/ha fb SHW and the weedy check no significant differences in pod number were observed among row spacings. At 90cm row spacing soyabean treated with Galex at 1.5kg a.i/ha fb SHW produced significantly higher number of pods per plant than the other herbicide treatments but comparable to the hoe-weeded control.

Galex at 3.0kg a.i/ha also caused higher pod number than the corresponding low rate at this soyabean spacing. Similarly hoe-weeding of all the herbicide treatments resulted in higher pod number than the same herbicide treatment alone.

In 1988, with application of Galex at 1.5kg a.i/ha soyabean pod number decreased with increase in row spacing (Table 133). However, when the same herbicide treatment was fb SHW soyabean at 60, 75 and 90cm were similar while those of 75 and 90cm were higher than that of 45cm spacing. In plots treated with Galex at 3.0kg a.i/ha alone soyabean plants spaced 45 and 60cm apart had similar number of pods that were higher than those at 75 and 90cm row spacing. But with Galex at 3.0kg a.i/ha fb SHW soyabean in 90cm row spacing had similar pod number with that at 75cm row spcaing but higher than those at 45 and 60cm. Soyabean in the hoe-weeded control had higher soyabean pod number in rows spaced 90cm than at 45, and 60 which were similar. In the treatment pod number at 75cm spacing was also higher than that of 45cm spacing. In the weedy check however, pod number increased with decrease in row spacing up to 60cm. In 45cm row spacing soyabean in plots treated with Galex at 1.5kg a.i/ha fb SHW produced more pods than that treated with Galex at 3.0kg a.i/ha fb SHW. At all spacings, SHW resulted in higher pod number than the corresponding herbicide alone, while without SHW Galex at 3.0kg a.i/ha resulted in higher pod number than the low rate at 60, 75 and 90cm spacings. With SHW, Galex at 3.0kg a.i/ha only resulted in higher pod number than the low rate at 45cm.

Table 130: Effect of row spacing and weed control treatments on number of pods per plant of soyabean at harvest at Samaru, 1984 to 1988 wet seasons.

Treatments	Number of pods per plant 1984	1985	1986	1988
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	65.2	77.3	74.6	75.3
60cm x 6.25cm	64.7	76.2	74.3	75.4
75cm x 5.00cm	65.3	74.9	74.3	75.3
90cm x 4.17cm	64.7	74.5	74.8	74.9
S.E (±)	0.06	1.36	0.66	0.51
Weed control treatment (W)				
Galex [3] at 1.5kg a.i/ha	60.6b [2]	72.3c	62.1d	67.9c
Galex at 1.5kg a.i/ha fb [4] SHW [5] at 6 WAS [6]	74.6a	84.0ab	84.5a	85.7a
Galex at 3.0kg a.i/ha	61.8b	79.6bc	65.6c	74.4b
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	76.3a	85.6a	81.8b	84.9a
Hoe-weeded at 3 and 6 WAS (Control)	76.7a	87.3a	82.8ab	84.9a
Weedy check	24.3c	41.9d	52.1e	40.8d
S.E (±)	0.72	1.66	0.81	0.62
Interaction				
I x W	* [7]	NS [1]	*	*

1/ Not significant
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
4/ Followed by.
5/ Supplementary hoe-weeding. 6/ Weeks after sowing 7/ Significant at 5% level of probability

Table 131: Interaction of row spacing and weed control treatments on number of pods per plant of soyabean at harvest at Samaru, 1984 wet season.

Weed control treatment	Number of pods per plant Row spacing (cm) 45	60	75	90
Galex at 1.5kg a.i/ha [1]	64.5cd [2]	62.0d	60.8d	55.3e
Galex at 1.5kg a.i/ha fb [3] SHW 6 WAS [4] [5]	70.0b	79.0a	79.0a	70.0b
Galex at 3.0kg a.i/ha	68.5bc	65.0cd	63.0d	50.8f
Galex at 3.0kg a.i/ha fb SHW 6 WAS	76.8a	78.0a	78.8a	78.5a
Hoe-weeded at 3 and 6 WAS (Control)	70.5b	79.0a	78.0a	79.3a
Weedy check	35.50g	28.00h	17.5i	16.3i
S.E (±)		1.43		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 132: Interaction of row spacing and weed control treatments on number of pods per plant of soyabean at harvest at Samaru, 1986 wet season.

Weed control treatment	Number of pods per plant Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	70.0e [2]	66.3ef	59.0g	53.3h
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	82.8cd	81.5cd	84.0cd	89.8a
Galex at 3.0kg a.i/ha	66.8e	69.3e	65.8ef	61.5fg
Galex at 3.0kg a.i/ha fb SHW 6 WAS	81.0cd	80.8cd	85.0bc	80.3cd
Hoe-weeded at 3 and 6 WAS (Control)	79.5d	80.5cd	81.8cd	89.5ab
Weedy check	50.8hi	58.8g	51.0hi	47.5i
S.E (±)		1.62		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 133: Interaction of row spacing and weed control treatments on number of pods per plant of soyabean at harvest at Samaru, 1988 wet season.

Weed control treatment	Number of pods per plant Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	76.3f [2]	72.0g	67.3h	56.0i
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	84.0bc	86.5ab	88.8a	88.5a
Galex at 3.0kg a.i/ha	78.3ef	78.3ef	71.3g	70.0gh
Galex at 3.0kg a.i/ha fb SHW 6 WAS	80.0de	83.0bcd	85.8ab	88.5a
Hoe-weeded at 3 and 6 WAS (Control)	81.3cde	86.5ab	85.3ab	88.3a
Weedy check	46.5j	46.3j	39.3k	31.3l
S.E (±)		1.25		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

4.2.9 **Number of seeds per pod**

The weed control treatments had significant effect on number of seeds per pod of soyabean in all the trials (Table 134).

All the herbicide treatments and the hoe-weeded control resulted in similar number of seeds per pods but significantly higher than those of the weedy check. The interaction of row spcaing and weed control treatments on the number of seeds per pod was also not significant.

Table 134: Effects of row spacing and weed control treatments on number of seeds per pod of soyabean at harvest at Samaru, 1984 -1988 wet seasons.

Treatments	Number of seeds per pod 1984	1985	1986	1988
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	2.1	2.2	2.2	2.1
60cm x 6.25cm	2.1	2.1	2.1	2.1
75cm x 5.00cm	2.1	2.0	2.1	2.0
90cm x 4.17cm	2.1	2.0	2.0	2.0
S.E (±)	0.03	0.09	0.09	0.09
Weed control treatment (W)				
Galex[3] at 1.5kg a.i/ha	2.2a[2]	1.9a	1.9a	2.0a
Galex at 1.5kg a.i/ha fb SHW[4] 6 WAS[5,6]	2.2a	2.3a	2.3a	2.3a
Galex at 3.0kg a.i/ha	2.2a	1.9a	2.1a	2.1a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	2.3a	2.3a	2.3a	2.3a
Hoe-weeded at 3 and 6 WAS (Control)	2.2a	2.2a	2.3a	2.3a
Weedy check	1.7b	1.8b	1.7b	1.5b
S.E (±)	0.04	0.11	0.11	0.11
Interaction				
I x W	NS[1]	NS	NS	NS

1/ Not significant
2/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
3/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
4/ Followed by 5/ supplementary hoe-weeding. 6/ Weeks after sowing
7/ Significant at 5% level of probability

4.2.10 1000-grain weight

The weed control treatments had significant effect on 1000-grain weight of soyabean in all the years (Table 135).

The weedy check resulted in significantly lower 1000-grain weight than all the other treatments in all the trials. In 1984,although grain weight of all the other weed control treatments were comparable to that of the hoe-weeded control, Galex at 3.0kg a.i/ha alone resulted in heavier grains than the herbicide at the low rate. In 1985 and 1986, with the exception of Galex at 1.5kg a.i/ha alone, all the herbicide treatments resulted in similar 1000-grain weight of soyabean. The interaction of row spacing and weed control treatments on 1000-grain weight of soyabean was not significant in the study.

Table 135: Effects of row spacing and weed control treatments on 1000-grain weight of soyabean at harvest at Samaru, 1984 -1988 wet season.

Treatments	1000-grain weight (gm) 1984	1985	1986	1988
Inter-row and Intra-row spacings (I)				
	1/			
45cm x 8.33cm	120.6	121.0	120.8	122.0
60cm x 6.25cm	121.3	121.4	120.7	122.7
75cm x 5.00cm	121.6	121.4	120.3	122.1
90cm x 4.17cm	121.8	121.4	120.4	122.3
S.E (±)	0.39	0.29	0.27	0.33
Weed control treatment (W)				
	4/	3/		
Galex at 1.5kg a.i/ha	122.4b	121.7c	122.2b	123.8a
	3/			
Galex at 1.5kg a.i/ha fb				
	6/ 1/			
SHW at 6 WAS	123.0ab	122.8ab	124.2a	123.5a
Galex at 3.0kg a.i/ha	124.2a	123.6a	124.8a	123.6a
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	123.0ab	123.9a	124.3a	123.9a
Hoe-weeded at 3 and 6 WAS. (Control)	123.0ab	122.8ab	124.4a	123.3a
Weedy check	110.23c	107.8d	106.7c	109.7b
S.E (±)	0.48	0.36	0.33	0.40
Interaction				
	2/			
I x W	NS	NS	NS	NS

1/ Weeks after sowing
2/ Not significant
3/ Means followed by the same letter(s) within the same column are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
5/ Followed by 6/ supplementary hoe-weeding.

4.2.11 Grain yield

Soyabean grain yield did not differ significantly among row spacings in all the years (Table 136). The weed control treatments had significant effect on soyabean grain yield in all the years, while the interaction of row spacing and weed control treatment on grain yield was significant in 1984 and 1988 (Table 137 to 138).

All the herbicide treatments and the hoe-weeded check resulted in significantly higher grain yield than the weedy check in all the years. The hoe-weeded control resulted in grain yield comparable to Galex at 3.0kg a.i/ha followed by SHW in all the years and Galex at 1.5kg a.i/ha followed by SHW in 1985, 1986 and 1988 but higher than those of the herbicide treatments without SHW. In all the years supplementing herbicide treatments with hoe-weeding significantly increased grain yield compared with the herbicide application alone. Similarly Galex at 1.5kg a.i/ha resulted in lower grain yields than Galex at 3.0kg a.i/ha except in 1985 when the difference was not significant. Galex at 1.5 and 3.0kg a.i/ha, each followed by SHW resulted in similar grain yields in all years.

The interaction of row spacing and weed control treatments showed that in 1984 (Table 137) the grain yield of soyabean treated with Galex at 1.5kg a.i/ha increased with decreasing row spacing. Similarly with Galex at 3.0kg a.i/ha alone, soyabean at 90cm spacing produced significantly lower grain yield than the other row spacings that were similar. With two hoe-weedings at 3 and 6 WAS and SHW of herbicide

applications no difference in grain yields among row spacings was observed. In the weedy check, soyabean planted at 60 and 75cm row spacings, produced higher grain yields than those at 45 and 90cm row spacings. Grain yield of soyabean at 45cm spacing was however higher than that in 90cm in the crop kept weedy throughout.

In 1988, with the application of Galex at 1.5kg a.i/ha, soyabean spaced 45 and 60cm apart produced comparable grain yield that were higher than those at 75 and 90cm spacings (Table 138). However, with the other herbicide treatments and the hoe-weeded control no difference in grain yields was observed among soyabean row spacings. In the weedy check, soyabean at 45 and 60cm row spacings produced higher grain yield than that at 90cm row spacing. Similarly, the soyabean planted at 45cm row spacings produced higher grain yield than that spaced 75cm apart in the weedy check.

Table 136: Effects of row spacing and weed control treatments on grain yield of soyabean at Samaru, 1984 -1988 wet season.

Treatments	Grain yield (kg/ha) 1984	1985	1986	1988
Inter-row and Intra-row spacings (I)				
45cm x 8.33cm	1497	1964	1264	1180
60cm x 6.25cm	1495	1931	1260	1217
75cm x 5.00cm	1528	1923	1385	1257
90cm x 4.17cm	1417	1846	1253	1131
S.E (±)	88.3	38.0	48.72	61.0
Weed control treatment (W) 2/				
Galex at 1.5kg a.i/ha	1394d 3/	1882b	1066c	1037c
Galex at 1.5kg a.i/ha fb 4/ 5/ SHW at 6 WAS 6/	1793a	2187a	1413ab	1423ab
Galex at 3.0kg a.i/ha	1663c	1944b	1269b	1371b
Galex at 3.0kg a.i/ha fb SHW at 6 WAS	1797a	2254a	1449a	1468a
Hoe-weeded at 3 and 6 WAS (Control).	1808a	2228a	1362ab	1457a
Weedy check	488e	1002c	652d	422d
S.E. (±)	10.10	46.60	59.69	19.72
Interaction				
I x W	* 7/	NS 1/	NS	*

1/ Not significant
2/ Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio.
3/ Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the Duncan's Multiple Range Test (DMRT)
4/ Followed by 5/ Supplementary hoe-weeding. 6/ Weeks after sowing
7/ Significant at 5% level of probability

Table 137:Interaction of row spacing and weed control treatments on grain yield of soyabean at harvest at Samaru, 1984 wet season.

Weed control treatment	Grain yield (kg/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	1532e [2]	1470f	1323g	1250h
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	1770ab	17.90ab	1793ab	1779ab
Galex at 3.0kg a.i/ha	1700c	1680c	1673c	1600d
Galex at 3.0kg a.i/ha fb SHW 6 WAS	1820a	1770ab	1790ab	1810a
Hoe-weeded at 3 and 6 WAS (Control)	1803ab	1790ab	1820a	1820a
Weedy check	520j	597i	595i	241k
S.E (±)		21.61		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same latter(s) within the same column or treatment are not significantly differently at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

Table 138: Interaction of row spacing and weed control treatments on grain yield of soyabean at harvest at Samaru, 1988 wet season.

Weed control treatment	Grain yield (kg/ha) Row spacing (cm) 45	60	75	90
Galex [1] at 1.5kg a.i/ha	1177c [2]	1161c	956d	854d
Galex at 1.5kg a.i/ha fb [3] SHW [4] 6 WAS [5]	1454a	1425ab	1422ab	1389ab
Galex at 3.0kg a.i/ha	1400ab	1394ab	1386ab	1304b
Galex at 3.0kg a.i/ha fb SHW 6 WAS	1487a	1459a	1476a	1455a
Hoe-weeded at 3 and 6 WAS (Control)	1487a	1422ab	1460a	1459a
Weedy check	529e	442ef	382fg	325g
S.E (±)		39.44		

1. Proprietory mixture of metolachlor plus metobromuron in 1:1 ratio
2. Means followed by the same letter(s) within the same column or treatment are not significantly different at 5% level of probability using the DMRT
3. Followed by
4. Supplementary hoe-weeding
5. Weeks after sowing
6. Row spacings: 45cm x 8.33cm, 60cm x 5.25cm, 75cm x 5.00cm, 90cm x4.17cm

4.2.12 Relationship between various parameters and grain yield in the weed control studies

4.2.12.1 Correlation Coefficient

In all trials there was a positive and highly significant correlation between soyabean grain yield and other crop parameters (Table 139 to 142) viz: soyabean ground cover, stand count at harvest, number of grains per pod, pods per plant, and 1000-grain weight (r = 0.736, 0.746, 0.778, 0.943, 0.853 respectively in 1984; 0.674, 0.537, 0.443, 0.888, 0.764 respectively in 1985; 0.562, 0.677, 0.383, 0.632 and 0.574 respectively in 1986; 0.761, 0.773, 0.582, 0.946, 0.789 respectively in 1988). Number of branches per plant was only correlated with grain yield in 1985, 1986 and 1988 with r value of 0.503, 0.291 and 0.571, respectively.However, the correlation was not significant with number of branches per plant in 1984. In all the years grain yield was highly negatively correlated with cumulative weed dry weight.

Cumulative weed dry weight in all the years was negatively correlated with all the other crop parameters such as number of branches per plant, ground cover, grains per pod, pods per plant and 1000-grain weight and grain yield (-0.077, -0.756, -0.705, -0.953, -0.761, -0.947 respectively in 1984; -0.466, -0.768, -0.537, -0.436, -0.830, 0.781, -0.86 respectively in 1985; -0.453, -0.735, -0.858, -0.493, -0.837, -0.793, -0.743, respectively in 1986; -0.566, - 0.830, -0.794, -0.583, -0.953, -0.789, -0.945 respectively in 1988).

In 1984, number of branches per plant was only positively

correlated with 1000-grain weight (r=0.232). In other years, the correlation of number of branches per plant with all other crop parameters was positive and highly significant except in 1985 when the correlation with number of grain per pod although positive was not significant.

Soyabean ground cover was positively and highly significantly correlated with stand count, number of grains per pod, pods per plant and 1000-grain weight. There was a postive and significant correlation between soyabean stand count at harvest and number of grains per pod, pods per plant and 1000-grain weight (r = 0.694, 0.776, 0.756 respectively in 1984; 0.235, 0.560, 0.538 respectively in 1985; 0.393, 0.829, 0.878 respectively in 1986; and 0.400, 0.754, 0.702 respectively in 1988). The correlation between number of grains per pod with number of pods per plant and 1000-grain weight on one hand and that between pods per plant with 1000 - grain height on the other hand were positive and highly significant.

Table 139: Correlation of weed dry weight, crop growth paramaters and yield of soyabean as influenced by row spacing and weed control methods at Samaru, 1984 Wet season.

	Cumulative weed dry wt.	No branches per plant	% ground cover	Stand count at harvest	No.of grains per pod	No.of pods per plant	1000-grain weight	Grain yield	
Cum. weed dry wt	1.000								
No. of branches/ plant	-0.077	1.000							
% ground cover	-0.756xx	0.114	1.000						
Stand count at harvest	-0.705xx	0.156	0.665xx	1.000					
No. of grains per pod	-0.756xx	0.199	0.681xx	0.694	1.000				
No. of pods/plant	-0.953xx	0.174	0.744xx	0.716xx	0.743xx	1.000			
1000-grain weight	-0.761xx	0.232*	0.698xx	0.756xx	0.705xx	0.767xx	1.000		
Grain yield	-0.947xx	0.186	0.736xx	0.746xx	0.778xx	0.843xx	0.853xx	1.000	

Values of 0.201 (P = 5%) and 0.262 (P = 1%) are significant.

Table 140: Correlation of weed dry weight, crop growth parameters and yield of soyabean as influenced by row spacing and weed control methods at Samaru, 1985 wet season

	Cumulative weed dry wt	No branches per plant	%ground cover	stand count at harvest	No of grains per pod	No of pods per plant	1000-grain weight	Grain yield
Cumulative weed dry weight	1.000							
No.branches/plant	-0.466xx	1.000						
% ground cover	-0.768xx	0.288xx	1.000					
Stand count at harvest	-0.537xx	0.259xx	0.556xx	1.000				
No of grains/pod	-0.426xx	0.082	0.319xx	0.235x	1.000			
No of pods per plant	-0.830xx	0.495xx	0.652xx	0.560xx	0.448xx	1.000		
1000-grain weight	-0.781xx	0.485xx	0.712xx	0.538xx	0.265xx	0.744xx	1.000	
Grain yield	-0.860xx	0.503xx	0.674xx	0.537xx	0.443xx	0.888xx	0.764xx	1.000

Values of 0.201 (P =5%) and 0.262 (P = 1%) are significant.

Table 141: Correlation of weed dry weight, crop growth parameters and yield of soyabean as infulenced by row spacing and weed control methods at Samaru, 1986 wet season

	Cumulative weed dry wt	No of branches per plant	% ground cover	stand count at harvest	No. of grains per pod	No of pods per plant	1000-grain weight	Grain yield
Cumulative weed dry wt	1.000							
No. branches/plant	-0.453xx	1.000						
% ground cover	-0.735xx	0.346xx	1.000					
Stand count at harvest	-0.858xx	0.428xx	0.844xx	1.000				
No. of grains/pod	-0.493xx	0.226x	0.328xx	0.393xx	1.000			
No. of pods per plant	-0.837xx	0.367xx	0.524xx	0.829xx	0.447xx	1.000		
1000-grain weight	-0.793xx	0.605xx	0.729xx	0.878xx	0.380xx	0.543xx	1.000	
Grain yield	-0.743xx	0.291xx	0.562xx	0.677xx	0.383xx	0.632xx	0.574xx	1.000

Values of 0.201 (r = 5%) and 0.262 (P = 1%) are significant.

Table 142: Correlation of weed dry weight, crop growth parameters and yield of soyabean as inflenced by row specing and weed control methods at Samaru, 1988 wet season.

	Cumulative Weed dry wt.	No of branches per plant	% ground cover	Stand count at harvest	No.of grains per pod.	No of pods per plant	1000-grain weight	Grain yield
Cumulative weed dry weight	1.000							
No. of branches /plant	-0.566xx	1.000						
Percent ground cover	-0.830xx	0.416xx	1.000					
Stand count at harvest	-0.794xx	0.465xx	0.717xx	1.000				
No. of grains/pod	-0.583xx	0.353xx	0.517xx	0.400xx	1.000			
No. of pods per plant	-0.953xx	0.516xx	0.777xx	0.754xx	0.561xx	1.000		
1000-grain weight	-0.789xx	0.640xx	0.647xx	0.702xx	0.401xx	0.781xx	1.000	
Grain yield	-0.945xx	0.571xx	0.761xx	0.773xx	0.582xx	0.946xx	0.789xx	1.000

Values of 0.201 (P = 5%) and 0.262 (P = 1%) are significant.

4.2.12.2 **Path Coefficient**

The path coefficient between soyabean grain yield and its yield attributes as well as the direct and indirect contributions of the yield characters to yield are shown in Table 143 and Figures 9-12.

The number of pods per plant had the highest direct contribution to grain yield in all the years (0.356, 0.672, 0.430 and 0.793 in 1984, 1985, 1986 and 1988, respectively). This was followed by the direct contribution of 1000-grain weight. The least direct contribution to grain yield was made by number of grains per pod (0.208, 0.077, 0.072, and 0.082 in 1984, 1985, 1986 and 1988, respectively).

As shown in Figures 9-12, the number of grains per pod indirectly contributed higher to grain yield via number of pod per plant in 1985, 1986 and 1988 while in 1984, the indirect contribution via 1000- grain weight was higher. Indirect contribution of number of pods per plant through 1000-grain weight was higher than through number of grains per pod in all the trials. The indirect contribution if 1000-grain weight to grain yield was higher through number of pods per plant in all the years (0.27, 0.50, 0.23, and 0.62 in 1984, 1985, 1986 and 1988, respectively) than through number of grains per pod.

Table 143: Direct and indirect contributions of different attributes to soyabean grain yield in the weed control trials at Samaru

Yield attributes	Contributions			
Number of grains per pod and yield	1984	1985	1986	1988
Direct contributions of grains per pod	0.208	0.077	0.072	0.082
Indirect contribution via pods plant	0.264	0.301	0.192	0.445
Indirect contribution via 1000-grain weight	0.305	0.064	0.119	0.055
Total contribution (direct and indirect)	0.778	0.443	0.383	0.582
Number of pods per plant and yield				
direct contributions of pod per plant	0.356	0.672	0.430	0.793
Indirect contributions via grains per pod	0.155	0.034	0.032	0.046
Indirect contribution via 1000-grain weight	0.332	0.181	0.170	0.106
Total contributions (direct and Indirect)	0.843	0.888	0.632	0.946
1000-grain weight and yield				
Direct contribution of 1000-grain weight	0.433	0.243	0.313	0.136
Indirect contribution via number of grain per pod	0.147	0.020	0.027	0.033
Indirect contribution via number of pods per plant	0.273	0.500	0.233	0.619
Total contributions (direct and indirect)	0.853	0.764	0.574	0.789

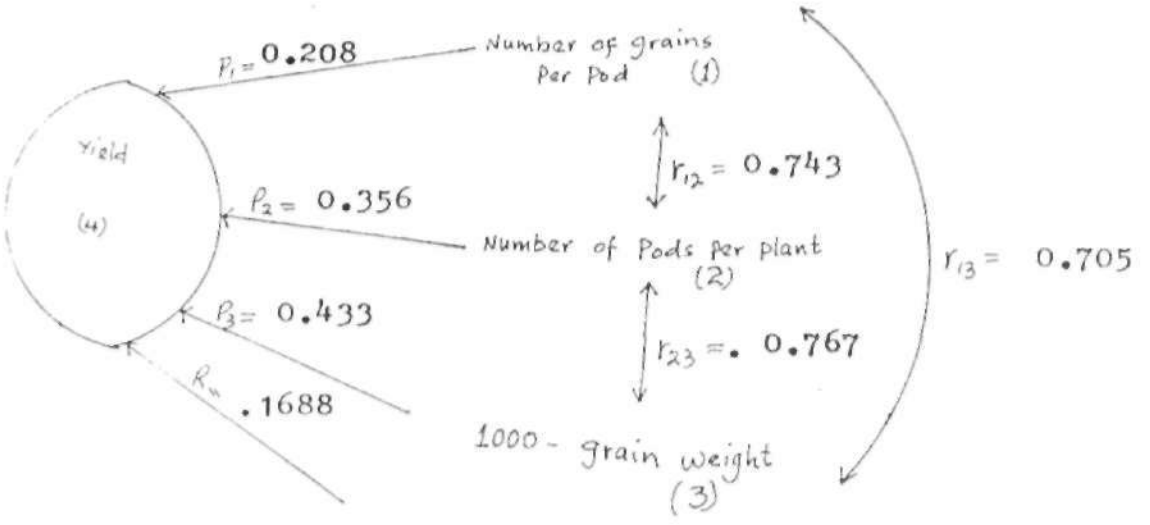


Fig. 9 : Path diagram showing interrelations of grain yield of soyabean and some of its yield components in 1984

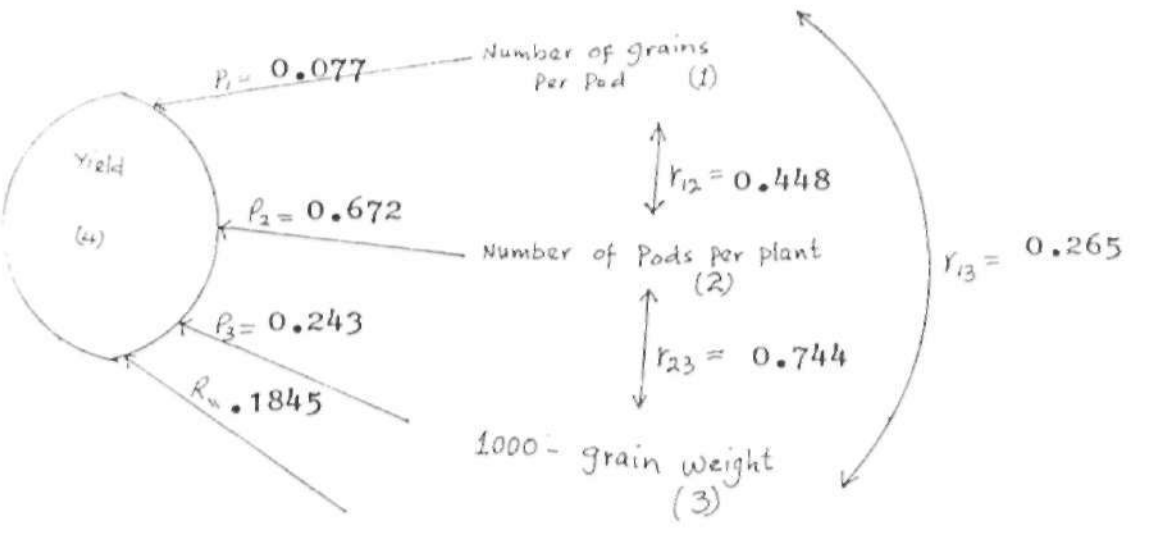


Fig. 13: Path diagram showing interrelations of grain yield of soyabean some of its yield components in 1985.

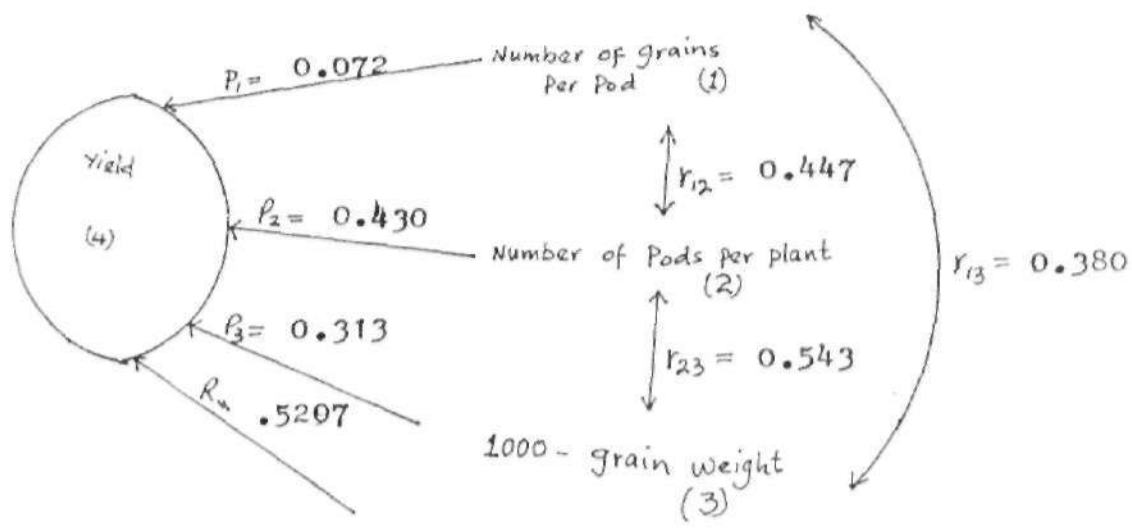


Fig. 11: Path diagram showing interrelations of grain yield of soyabean and some of its yield components in 1986.

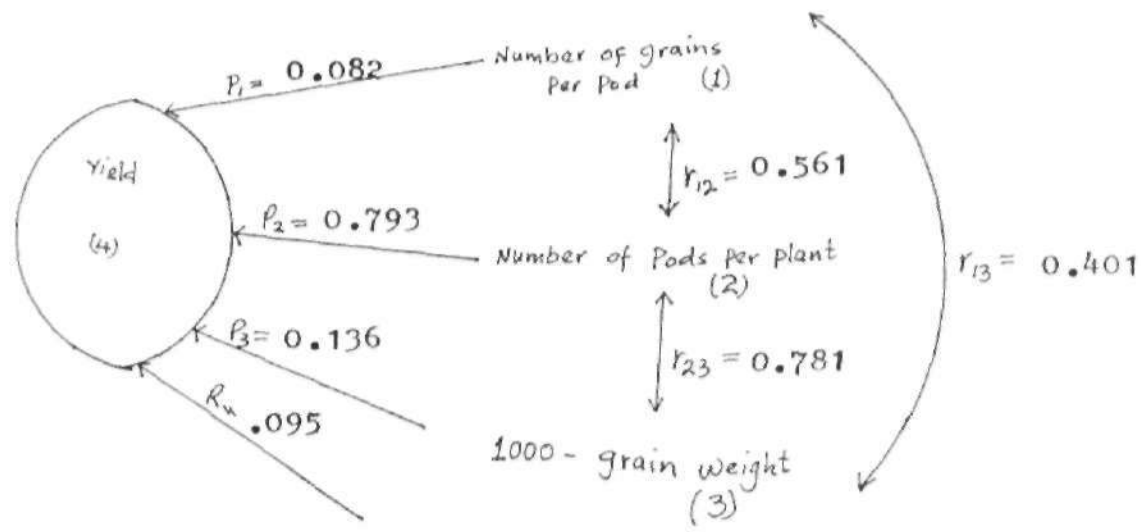


Fig. 12: Path diagram showing interrelations of grain yield of soyabean and some of its yield components in 1988.

4.2.12.3 **Percentage contribution**

Table 144 shows the percentage contribution of the yield attributes both individually and combined to soyabean grain yield. The individual percentage contribution of number of pods per plant was highest in 1985, (45.2%), 1986 (18.5%) and 1988 (62.9%) followed by the individual percentage contribution of 1000-grain weight. However, in 1984 the individual percentage contribution of 1000-grain weight was highest (18.8%) followed by that of number of pods per plant (12.7%). In all the years, number of grains per pod had the least individual percentage contribution of 4.3, 0.6, 0.5 and 0.7% in 1984,1985, 1986 and 1988, recpectively.

When the combined percentage contributions of any two characters were considered, the contribution of number of pods plant and 1000-grain weight gave the highest percentage contibution all the years, followed by the combined contribution of number of grains per per pod and 1000-grain weight in 1984 (12.7%) and the combined percentage contributions of number of grains per pod and number of pods per plant in 1985, 1986 and 1988. The least combined percentage contribution to yield in 1984 was from number of grain number of per pod and number of pods per plant, while in 1985, 1986 and 1988 it was from the combined contribution of number of grains per pod and 1000-grain weight. The unaccounted residual contribution ranged from 9.5% in 1988 to 52.1% in 1986.

Table 144: The percentage contribution of different yield characters to yield in the weed control trials at Samaru

Yield attributes	Percentage contribution			
Individual contributions	1984	1985	1986	1988
Number of grains/pod	4.33	0.59	0.52	0.67
Number of pods/plant	12.67	45.16	18.49	62.88
1000-grain weight	18.75	5.90	9.80	1.85
Combined contributions				
Number of grains/pod and pods/ plant	11.00	4.64	2.77	7.30
Number of grain/pod and 1000-grain weight	12.70	0.99	1.71	0.89
Number of pods/pant and 1000-grain weight	23.65	24.30	14.62	16.85
Residual	16.88	18.45	52.07	9.48
Total	99.98	100.03	99.98	99.92

CHAPTER 5

DISCUSSION

5.1 Effect of spacing on weeds and soyabean.

Spacing had significant effect on weed dry weight at all stages of crop growth in both the weed control and weed competition trial except at harvest in 1984 in the weed competition trial; the closest inter-row spacing of 45cm resulted in significantly lower weed dry weights than 75 and 90cm. The significant reduction in weed dry weight at harvest of 38.3% in 1984, 42.9% in 1985 39.7% in 1986 and 29.1% in 1988 in the weed control trial and 46.2% in 1985, 36.4% in 1986 and 46.7% in 1988 in the weed competition trial obtained with 45cm row spacing compared with 90cm could be attributed to the earlier canopy closure at 45cm spacing and better smothering of the weeds. In addition Soyabean plants were more vigorous in growth and taller at 45cm than 90cm wherever there were significant differences in crop vigour scores between spacings. These probably facilitated effective canopy formation for weed suppression. These findings are in agreement with those of Kust and Smith (1969) who observed that weed control increased as row spacing decreased in soyabean. Dougherty (1969) also proposed that the shading of weeds by the quickly formed canopy of soyabean planted in narrow rows accounted for more effective weed control than in the wide rows. Peters et al.(1965) and Teasdale and Frank (1983) also reported better weed control in narrower than

wider rows of soyabean due to the earlier ground cover in the narrower row spacing.

At 6 WAS soyabean spaced 45cm apart covered 30.8% (1984) 30.1% (1985) 28.1% (1986) and 34.7% (1988) more ground than soyabean spaced 90cm apart between rows. This happened because soyabean spaced 45cm apart had 22.5cm in each furrow to cover to achieve 100% ground cover while that in 90cm row spacing had twice as much area to cover to achieve the full ground cover. Row spacing had no significant effect on grain yield of soyabean in all the trials. Although growth characters such as crop vigour score, ground cover and plant height were influenced by row spacing, the number of branches per plant, pods per plant and 1000-grain weight did not differ significantly among the row spacings. The similarity in grain yields observed in all spacings could be due to the constant plant population of 266,666 Plants per hectare maintained in each spacing. In a study on effects of plant density, row spacing and cultivar on grain yield of soyabean at Samaru Olufajo (1996) had that the various row spacing of 25, 50 and 75cm significant effect of row spacing on soyabean grain yield when grown at 266,666 plants /ha. The higher soyabean grain yields obtained with 45cm compared with 60 and 90cm reported by Anaele and Bishnoi (1992) could be due to the higher plant population used at the 45cm row spacing.

.2 <u>Effect of Weed interference on Soyabean</u>

In all the trials, weed infestation of the Soyabean

initially for 3 WAS only did not have any significant effect on any of the crop growth parameters and grain yield. Similarly, keeping the crop weed free initially for 3 WAS only did not alleviate crop yield loss. All these observations imply that the weeds at this stage were too young to adversely affect crop growth.

At this stage too the crop plants were very young, at 3 - 5 leaf stage, and therefore had low requirement from the abundantly available moisture, soil nutrients and sunlight. Investigations in the same ecology had shown that weed infestation for the first three weeks did not cause significant reductions in the growth and yield of pepper (Adigun et al. 1991), cotton (Dadari, 1983), maize/pepper mixture (Bakut, 1985), potato (Bulus, 1986) cowpea (Sule, 1988) and maize (Magani, 1991). However, initial weed infestation for 6 WAS and beyond resulted in significant depression of various crop growth parameters such as crop vigour score, number of branches per plant, percent ground cover and yield and yield attributes such as number of pods per plant and 1000-grain weight compared with the crop kept weed -free throughout the crop life cycle. To obtain comparable yield to the weed -free control it was required to keep the crop weed -free for 6 WAS and beyond. This is in agreement with the findings of Vega et al. (1968) in the Philippines and Hammerton (1972) in Trinidad.

Yield obtained from plots kept weed-free initially for

the first 6 WAS and later were higher than those obtained from plots weed infested initially for the same period. This shows that early weed interference is more important than the late interference. Weed growth and interference with the crop is very serious between 3 and 6 WAS, a period that coincides with the critical part of the vegetative phase of the crop. At this stage however, the crop would not be able to compete effectively with the weeds. It is therefore advantageous to control weeds at the critical stage of the crop. Since allowing weeds to infest the crop at this tender stage could result in growth depression and consequent yield reduction.

.3 Critical period of weed competition

Figures 5 to 8 show that the critical period of weed competition in soyabean was between 3 and 6 WAS in all the years. This is in agreement with the findings of Wax and Slife (1967) in the U.S.A who reported that soyabean kept weed-free for one month after sowing produced grain yield that did not differ significantly from that of the crop kept weed free throughout the season. This period coincides with the period when weeds were rapidly growing and thus effectively competing with the crop for soil nutrients, light and moisture. Therefore if the crop was allowed to be weed infested beyond 6 WAS, subsequent weeding did not improve crop yields significantly compared to the crop weed-infested throughout the crop life cycle.

Season-long weed infestation resulted in 60.5 - 66.o%

reduction in soyabean grain yield compared to the maximum obtained from season - long weed control. In Nigeria, Akobundu (1980) and Ayeni (1985), both working in the Southern Guinea Savanna ecology reported 60.0% and 75.6% yield loss from uncontrolled weeds, respectively while in the Northern Guinea Savanna grain yield loss due to uncontrolled weeds has been reported to be between 23 and 77% (Shebayan and Lagoke, 1986; Lagoke and Shebayan, 1994).

5.4 Effect of weed control treatment on weeds and soyabean.

Inspite of high weed infestation, all the herbicide treatments redued weed infestation at various levels as reflected in the lower weed dry weight and cumulative weed dry weights obtained with the treatments compared with the weedy check. All the herbicide treatments followed by SHW resulted in weed dry weights at harvest comparable to the hoe-weeded control in all the years except 1984. Herbicide treatments supplemented with a hoe-weeding at 6 WAS resulted in lower dry weights than their corresponding rates not supplemented with a hoe-weeding. Also herbicide treatments without SHW generally resulted in higher weed dry weights than the hoe-weeded control. Except in 1984 when Galex at 1.5kg a.i/ha gave higher weed dry weight at harvest than galex at 3.0kg a.i/ha. There were no significant differences in weed dry weights at harvest between these two herbicide rates. This shows that supplementary hoe-weeding was necessary despite the rate of galex used. The need for supplementary by hoe-weeding or post

-emergence herbicides had been stressed by several workers in cowpea (Akobundu, 1978,1990, 1982, and 1988), groundnut (Adeleke, 1984) and Soyabean (Shebayan and Lagoke, 1988). Chandra-Singh and Lagoke (1982) observed that SHW at 6 WAS to plots treated with Galex at 2.0kg a.i/ha effectively controlled later-emerging weeds such as *Rottboelia* and gave high soyabean grain yields comprable to the hoe-weeded check. Soyabean in the herbicide treatments had high stand counts than those in the weedy check. Weed competition for up to 12 weeks after sowing had been observed to reduce crop stand (Barrentine, 1974). Similarly, soyabean in the herbicide treated plots had higher crop vigour scores, percent ground cover, number of branches per plant, number of pods per plant, number of seeds per pod and 1000 grain weight than the unweeded check. The hoe-weeded control gave comparable stand count, crop vigour score, number of branches per plant, number of pods per plant and 1000-grain weight to the maximum obtained in the trial. The generally high crop vigour scores of the herbicide treatments with and without SHW and the hoe-weeded control could be attributed to the rapid growth of the crop which resulted in the good ground cover. At 12 WAS, each rate of Galex followed by SHW caused higher crop vigour score than the corresponding rate without SHW.

In all the years, Galex at 3.0kg a.i/ha followed by SHW gave the highest grain yield although was comparable to the hoe-weeded control. Uncontrolled weeds throughout the crop

life cycle resulted in 73.0,55.5,55.0 and 71.3% grain yield reduction relative to the maximum obtained in 1984,1985,1987 and 1988, respectively. This is in line with the grain yield loss of 60% and 75.6% reported earlier in the Forest and Derived savanna ecologies by Akobundu (1980) and Ayeni (1985) respectively. Also in the Northern Guinea Ssavanna ecology, Shebayan and Lagoke (1987) and Lagoke et al.(1991) have reported grain yield losses of between 23 and 77% due to uncontrolled weed infestation of soyabean. The higher soyabean grain yield loss observed in 1984 and 1988 could be due to the higher weed challenge from later-emerging broadleaf weed such as *Vernonia galamensis* and *Acanthospermum hispidum.* Several workers have reported that weeds reduced soyabean grain yield through reduction in crop growth and yield parameters especially shoot dry weight leaf area, and number of pods per plant (James et al., 1974; Knake and Slife, 1969, Wyse, 1980) grains per pod and grain size (Moolani et al., 1964; Eaton et al.,1969; Drennan and Jenning, 1977). In all years Galex at 1.5kg a.i/ha and 3.0kg a.i/ha, each followed by SHW, resulted in higher soyabean grain yield than the corresponding rates alone. In all the years the Galex at 1.5kg a.i/ha resulted in lower grain yield than Galex at 3.0kg a.i/ha alone. This is due to the better weed control at the higher rate as reflected in the lower weed cover and weed dry weights Akobundu et al (1994) had recommended 2.5kg a.i/ha of Galex for weed control in soyabean in the Nigeria savanna. However, in all the years,

except 1984, Galex at 1.5 and 3.0kg a.i/ha followed by SHW resulted in similar soyabean grain yield.

5.5 CORRELATION AND PATH COEFFICIENT

In this study, soyabean grain yield was highly positively correlated with number of branches per plant, percent ground cover, stand count, number of pods per plant and 1000 - grain weight in each of the seasons except in 1984 in the weed interference trial when percent ground cover had a negative but not significant correlation, and in the weed control trial when the correlation of number of branches per plant was positive but not significant. The stand count determined the plant population per unit land area and therefore determined the grain yield. The number of branches determined the number of flowers/pods per plant as well as the ground cover. The percent ground cover determined the amount of light received for the manufacture of photsynthate for plant growth and grain yield.

The highly significant and positive correlation between these parameters and grain yield confirmed the importance of the yield components as critical determinants of soyabean grain yield as earlier observed by Reuben (1988). Plant height and branches/plant were important in determining pods per plant which in turn made significant contribution to yield per plant.

Cumulative weed dry weight had significantly nagative correlation with soyabean grain yield. Increased weed growth

resulted in higher weed-crop competition for soil nutrients, water and light with consequent soyabean grain yield reduction. Negative correlations have been reported between weed dry weight and yield of maize and pepper (Bakut, 1985), sweet potato (Bulus, 1988), cowpea (Sule, 1988) and tomato (Adigun, 1991).

The path analysis showed and percentage contribution showed that the yield components made their greatest contribution to yield through number of pods per plant, followed by 1000-grain weight. As earler reported by Lal and Haque (1976) Pandey and Torrie (1973) and Reuben (1988) This confirms the importance of these characters in the yield of soyabean. In the weed control trial in 1984, 1000-grain weight contributed higher to grain number of pods per plant due to the reduction in number of pods per plant as a resuit of the insufficient rains at the earler part of the season (Table 2). The improved rains later in the season enhanced grain filling. The lower contribution of number of branches per plant to yield in the weed competition trial could be due to the increased competition for assimilate due to increase in number of pods per plant with increase in number of branches per plant.

CHAPTER 6

SUMMARY AND CONCLUSION

Field trials were conducted in 1984 to 1988 to study the effect of inter-row spacing on the response of soyabean (Glycine max (L.) Merill) to weed interference and management on the farm of the Institute for Agricultural Research, Samaru (11° 11'N, 07° 38' E) in the northern Guinea savanna ecological zone of Nigeria.

In the weed interference study, four soyabean inter-row spacings, 45, 60, 75 and 90cm were assigned to the main plots but each had intra-row spacing adjusted to give a total soyabean plant population of 266,666 plants/ha while the ten periods of weed interference were the sub-plot treatments. In the first set, of treatments, the plots were initially kept weed -free for 3,6,9 and 12 weeks after sowing and subsequently left unweeded until harvest. The other set of treatments had the crop left initially weed - infested for the corresponding periods and subsequently controlled until harvest. Two treatments of weed - infested and weed - free plots throughout the crop growth were included as controls.

In the study on weed management, four inter-row spacings 45,60,75 and 90cm, each with an intra-row spacing to give 266,666 plants/ha, were the main plot treatments while the subplot treatments consisted of six weed control treatments which were Galex at 1.5 and 3.0kg a.i/ha either applied alone or followed by supplementary hoe-weeding. These were compared

with a hoe-weeded control weeded at 3 and 6 weeks after sowing and a weedy check kept weed-infested throughout the crop life-cycle. The treatments were laid out in a split-plot design with four replications.

The results obtained showed that the closest inter-row spacing of 45cm resulted in significantly lower weed cover score and cumulative weed weight than 75 and 90cm in all the years except 1984. Inter-row spacing of 45cm also had higher ground cover and taller plants than 75 and 90 cm inter-row spacing. The grain yields were however not influenced by row spacing.

In the weed interference study, initial weed infestation of soyabean for only 3 WAS did not have significant effect on any of the crop growth parameters and soyabean grain yield provided the weeds were subsequently removed. However, weed-infestation for 6 WAS and more significantly depressed the crop growth parameters viz crop vigour score, plant height, number of branches per plant as well as number of pods per plant, number of grains per pod, 1000-grain weight and grain yield compared with the crop kept weed - free throughout its life cycle.

To obtain soyabean grain yield comparable to that obtained in the plot kept weed - free till harvest it was necessary to keep the crop weed-free initially for 6 WAS and more.

In the weed control trials the use of herbicides and hoe-

weeding consistently resulted in significantly lower weed cover score and weed dry matter production compared with the weedy check. In addition, supplementary hoe-weeding resulted in significantly lower weed cover score, weed dry weight at harvest and cumulative weed dry weight than the weedy check but comparable to the hoe-weeded control in all the years except in 1984. Each herbicide rate supplemented with one hoe-weeding at 6 WAS resulted in lower weed score and weed dry weight than its corresponding rate not supplemented with a hoe-weeding. The herbicide treatments not supplemented with a hoe-weeding gave higher weed scores and weed dry weights than the hoe-weeded control. Except in 1984, when Galex at 1.5kg a.i/ha gave higher weed dry weight at harvest than Galex at 3.0kg a.i/ha, there were no significant differences in weed dry weight at harvest between both rates of the herbicide.

Soyabean in the herbicide-treated plots gave higher vigour scores, perccent ground cover, number of branches per plant, number of pods per plant, number of seeds per pod and 1000 grain weight than the weedy check. The hoe-weeded control was comparable to the best herbicide treatment in these parameters. Galex at 3.0kg a.i/ha followed by SHW gave the highest grain yield but was comparable to Galex at 1.5kg a.i/ha follwed by SHW and. the hoe-weeded control.

In this study, uncontrolled weed growth throughout the crop life-cycle resulted in 55.0% to 73.0% reduction of soyabean grain yield compared with the maximum obtained in the

trial. Soyabean grain yield was positively correlated with soyabean stand count, plant height, ground cover, number of branches per plant, pods per plant, grains per pod and 1000-grain weight and negatively correlated with cumulative weed weight. Number of pods per plant and 1000-grain weight were major contributors to grain yield and were most affected by weed competition.

In conclusion, the results obtained in this study showed that inter-row spacing of 45cm resulted in lower weed cover score, weed dry weight and cumulative weed weight than 75 and 90cm row spacings. Significant differences were however not observed in soyabean yield and yield attributes at the constant plant population of 266,666 plants/ha maintained irrespective of row spacing.

Initial weed infestation for 3 WAS did not have significant effect on all the growth parameters and yields of soyabean provided the weeds were subsequently removed. Similarly, crop yield loss was not allevated by keeping the crop weed-free initially for only the first three weeks of growth. In order to obtain statistically similar yield to the weed -free control it was required to keep the crop weed-free for 6 WAS and more.

This study also showed that chemical weed control was necessary for timely weed control and obviating the drudgery associated with manual weed control. Among the herbicide treatments, Galex at 1.5kg a.i/ha alone gave higher weed score

and dry weight than Galex at 3.0kg a.i/ha. The two rates gave significantly lower soyabean grain yield than its corrsponding rate supplemented with one hoe-weeding at 6 WAS. No significant differences in soyabean grain yield were observed between 1.5kg a.i/ha and 3.0kg a.i/ha of Galex, each followed by one hoe-weeding at 6 WAS.

It was apparent that the herbicide treatment required the supplementary weed control to exhibit its potential and give season long weed control as expressed in the grain yield of soyabean irrespective of the rate. To obviate the need for the supplementary weed control by hoe-weeding or post-emergence herbicides there is the need to screen more herbicides and herbicide mixtures.

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BIOGRAPHY

NAME: Joseph Akimbo Yusufu SHEBAYAN

DATE OF BIRTH: 15TH July, 1955

PLACE OF BIRTH: Gizagwai, Moro'a

STATE OF ORIGIN: Kaduna

MARITAL STATUS: Married with four children.

BUSINESS ADDRESS: Agronomy Department
Institute for Agricultural Research,
Ahmadu Bello University
P.M.B 1044
Zaria.

HOME ADDRESS: Anturung Road,
Gizagwai, Moro'a
P.O.Box 125,
Via Kafanchan

PREVIOUS ACADEMIC QUALIFICATIONS

INSTITUTIONS ATTENDED	FROM	TO	CERT./DEGREE AWARDED
Govt. Sec. School, Fadan kaje	1969	1973	WASC. Div. II
Sch. of Basic Studies ABU, Zaria	1974	1975	IJMB
Ahmadu Bello University, Zaria	1975	1978	B.Sc. (Agric) 2.1
Ahmadu Bello University, Zaria	1980	1982	M.Sc. (Agron)

POSTS HELD SINCE AWARD OF FIRST DEGREE

ORGANISATION	POSITION	FROM	TO
Ondo state Cocoa Dev. Unit Akure	Farm Inspector (NYSC)	1978	1979
Institute for Agric. Research ABU., Zaria.	Graduate Asst.	1979	1980
Institute for Agric. Research ABU., Zaria.	Asst. Res. Fellow	1980	1983
Institute for Agric. Research ABU., Zaria.	Research Fellow II	1983	1989
Institute for Agric. Research ABU., Zaria.	Research Fellow I	1989 to date	

YEAR OF AMISSION FOR POSTGRADUATE STUDIES: 1982/83 REGISTRATION NUMBER: Ph.D/Agric./55087/82-83