EFFECT OF WEED CONTROL TRE EFFECT OF WEED CONTROL TREATMENTS ON MAIZE (*Zea mays* L.) VARIETIES IN NORTHERN GUINEA SAVANNA OF NIGERIA

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AHMADU BELLO UNIVERSITY,

ZARIA, NIGERIA

JANUARY, 2022

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTERS OF SCIENCE IN AGRONOMY

DEPARTMENT OF AGRONOMY,

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ZARIA, NIGERIA

JANUARY, 2022

DECLARATION

I declare that the work in this dissertation entitled Effect of weed control treatments on maize varieties (*Zea mays* L.) in Northern Guinea Savanna of Nigeria has been written by me in the Department of Agronomy under the supervision of profs M.A. Mahadi and A.I. Sharifai. The information derived from the literature is duly acknowledged in the text and list of references provided. No part of this dissertation has been previously presented for another degree or diploma in any University.

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Prof M.A. Mahadi _____
(Chairman, Supervisory Committee) Date

CERTIFICATION

The dissertation entitled 'EFFECT WEED CONTROL TREATMENTS ON MAIZE (*Zea mays* **L**) VARIETIES IN NORTHERN GUINEA SAVANNA OF NIGERIA' By Dahiru Sanda Ruma meets the regulations governing the award of the degree of M.Sc Agronomy of Ahmadu Bello University, Zaria and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This research work is dedicated to my parents late Magaji Sanda Chiroma Ruma and Malama Mairo Sanda Ruma whose foresight and sacrifice laid a solid foundation in my life. Special dedication goes to my wife Zulaihat Aminu Ruma and children for their moral support during the course of the study.

ACKNOWLEDGEMENT

It is absolutely imperative to commence by giving thanks, honor, praises and adorations to the Highest, the Architect of the Universe, Almighty Allah, whom in His foreseen wisdom makes Agronomy among the ultimate source of sustenance for his creature. Special thanks goes to this great institution Ahmadu Bello University, Zaria for offering me admission, training and facilities which led to realization of this consolidating step in my academic pursuit.

My heartfelt appreciation goes to my supervisors Profs M.A Mahadi and A.I Sharifai of the Department of Agronomy, Ahmadu Bello University, Zaria for their instrumental guidance which became the vital and inspirational element of this work. Therefore, their words have become light in my career in this profession. I humbly admired their brilliant ideas, patience and encouragement as well as their charismatic leadership.

I am also grateful to the entire staff of the Department of Agronomy, Ahmadu Bello University, Zaria. I will also like to forward my regards to my classmate and friends that remained ever at my disposal and fully committed to the success of this project. More so, my worthy appraisal to all those whose names are not mentioned.

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ABSTRACT

Field trials were conducted during the rainy season of 2020 at the research farms of the Institute for Agricultural Research, Samaru Zaria (11º 11' N, 7º 38' and 686m above sea level) and the College of Agriculture and Animal Science, Mando (7.43º N, 8.33º E and 632m above sea level) all in Northern Guinea Savanna of Nigeria to access the effect of weed control treatment on maize varieties. The treatment consists of six weed controls options (Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus hoe weeding at 6WAS, Nicosulfron at 0.7 kg ai ha^{-1}, Nicosulfron at 0.7 kg ai ha^{-1} plus hoe weeding at 6WAS, hoe weeding at 3 and 6WAS, and weedy check) and three varieties of maize (SAMMAZ 17, SAMMAZ 29 and SAMMAZ 54). The treatments factors were combined and laid in Randomized Complete Block Design in Split plot arrangement and replicated four times. The dominant weed specie observed were *Ageratum conyzoides, Cyperus rotundus, Digitaria horizontalis* which have 35 to 75% level of occurrence. All weed control enhanced the performance of maize, even though, application of Nicosulfron at 0.7 kg ai ha^{-1} performed better and resulted in better crop establishment, reduced weed cover score, weed dry weight and weed density. Plots treated with Nicosulfron at 0.7 kg ai ha^{-1} resulted in better plant height, number of leaves and leaf area index, Other parameters that were enhanced by application of Nicosulfron at 0.7 kg ai ha^{-1} were crop growth rate, relative growth rate, number of cobs per plot, cob diameter and grain yield. However, among the weed controls treatments application of Nicosulfron at 0.7 kg ai ha^{-1} plus supplementary hoe weeding gave better weed control over the weedy check with the yield increase of (40%) at Samaru and 59% at Mando. Generally, all the varieties responded positively but SAMMAZ 17 resulted in higher value for the measured growth and yield parameters at both locations. However, there was a positive and highly significant correlation between grain yield and growth and yield parameters such as plant height, shoot dry weight, leaf area index. Grain yield was negatively correlated with weed cover score, weed dry weight and weed density.

Application of Nicosulfron at 0.7ai kg. ha^{-1} plus hoe weeding at 6 WAS resulted in better weed control, SAMMAZ 17 produced higher grain yield at both locations.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Origin and Distribution of Maize

Maize (*Zea Mays* L.) originated in central Mexico around 5,000 BC. (Burleigh, 2016). *Zea Mays* belongs to the tribe Maydae of the family Poaceae. It possesses over 32,000 genes on ten chromosomes with a genome size of 2.3 gigabase Girei *et al.* (2018). Among various theories, teosinte (*Z. mays* ssp. *parviglumis*) is the most likely progenitor of maize. Genetic loci such as *teosinte branched 1* (*tb1*) and *teosinte glume architecture 1* (*tga1*) have played pivotal role in transforming teosinte to modern maize (Hossain, *et al.*, 2016) through human selection on annual teosinte *Zea mays* L. subsp. *parviglumis* according to Matsuoka *et al* (2002).

Maize spread first into the lowlands of South America and finally into the Andes Mountains (Matsuoka *et al.* 2002). The crop was introduced to Europe in the sixteenth century, from where it spread to Africa and Asia. It is now one of the most widely-grown crops around the world in both temperate and tropical regions (Burleigh, 2016). Weeds have a more influence on human beings than any other pest development, weeds not only cause severe crop losses but also compete with farmers and their families. Although maize did not originate in Africa. Maize is, perhaps, the most important cereal crop of significant economic importance in African countries that has replaced sorghum and millet (Amudalat, 2015).

Maize crop occupies the third position next to rice and wheat in area and production. Of the 22 countries in the world where maize forms the highest percentage of calorie intake in the national diet, 16 are in Africa FAO, (2009). Maize is known as queen of cereals because of its highest genetic yield

potential among cereal. An estimated 208 million people in Sub-Saharan Africa depend on maize as a source of food security and economic wellbeing. Maize occupies more than 33 million ha of SSA's estimated 200 million ha of cultivated land (Harold, 2015). Maize is one of the most important staple foods in Nigeria and it has grown to be local 'cash crop' (Girei *et al.*, 2018).

1.2 Maize Production

Maize has become the second most produced crop in the world. Specifically, in sub-Saharan Africa, global statistics show that more and more land is being used for (small-scale) maize production to meet future food demands. From 2007 to 2017, the area on which maize is grown in sub-Saharan Africa has increased by almost 60% (Romy, 2020). FAO, (2009) stated that world production in 2012 was over 870 million tons, grown on 158 million hectares of land. Girei *et al.* (2018) stated that about 561, 397, 29 hectares of Nigerian land were planted with maize, which constitutes about 61% of total cultivable land in Nigeria. Furthermore, the FAO, (2009) reported that Nigeria produced 10.5 Million metric tonnes of maize in 2016/2017. The average yield of maize in the world, Africa and Nigeria were 4.3 t ha $^{-1}$, 2.0 t ha^{-1} and 1.8 t ha^{-1} FAOSTAT, (2014). In Nigeria kaduna state is the highest producing state with the average yield of 2 t ha^{-1} KADP, (2001) followed by Taraba and Bauchi.

1.3 Soil and Climatic Requirement

Maize can be grown on a variety of soil types however, deep, fertile, rich in organic matter and well drained soils are the most preferred ones for the crop. The soil should be medium textured with good water holding capacity (Wilson *et al*., 2019). The crop is very sensitive to water logging and since it is mainly grown during rainy season, care should be taken to assure that water does not stagnate on the soil surface for more than 4-5 hours. Loamy, silty loam soil or silty clay loam soils having fairly permeable sub soil is ideal soil types. Thus, the ideal soil is neither clayey or sandy and has a pH

between 6.5 and 7.5 along with an exchangeable capacity of around 20 milli-equivalent/100g, base saturation of 70-90%, bulk density of about 1.3 g/cc and water-holding capacity of about 16cm/m depth (Wilson *et al.,* 2019).

Maize requires 9 to 30°C from planting to emergence, from emergence to silking, leaf number increases with temperature and photoperiod. Increase in time to tassel as the diurnal variation increase from 0-17°C (Wilson *et al.,* 2019). Maximum rate of maize growth is at 30°C. The longer the grain filling period, the higher the grain yield provided no freezing temperature. Higher the solar radiation, higher will be the photosynthesis in maize.

1.4 Economic Importance of Maize

Maize is one of the most important cereal crops in the world. It provides staple food to many populations, feed for livestock, for fermentation and many industrial uses. In the developing countries maize is a major source of income to farmers among whom many are resource-poor farmers (Tagne, Feujio and Sonna 2008). Maize is milled to produce a variety of product. There are two types of milling. Wet milling produces industrial starch like sweeteners, also produces various modified maize starch for paper lamination, textile wrap, sizing and laundry finishing. Dry milled products are animal feed, brewing, breakfast cereals, other food. Maize is very important because is a good source of minerals, vitamins, fiber and oil present in maize (Huma *et al.,* 2019). The oil in corn (rich in embryo) is far and widely used for cooking and manufacture of soaps. Sticky gum contains dextrin used for sealing envelopes and labels (Dilip and Aditya 2013). Maize starch is famous in pharmaceutical Industries as diluents and also used in cosmetics (Huma *et al*., 2019). Corn seeds are functional in making alcohol and stem fibres for manufacture of paper (Dilip and Aditya 2013). Maize is cultivated in 166 countries; maize has become the most abundant crop globally as a result of this versatility. As well as being directly consumed as food, maize is now used at a large-scale mainly in the production of

feed for the poultry and meat industry and for the production of fructose/glucose, flour, oils and ethanol (CONABIO, 2017).

1.5 Justification of the Study

Maize farmers face a lot of production constrains among which is weed competition (Opaluwa *et al.*, 2015). Weeds compete with the maize for soil nutrients and other environmental resources. Maize is said to be highly susceptible to weed competition particularly at the early stages of growth (Evans *et al.,* 2003). It is required that maize plot be kept weed-free between planting and 6 weeks after planting which is the critical period of weed interference, in order to get optimal yield (Imoloame and Omolaiye, 2017). Farmers in Nigeria spend more time in controlling weeds than on any other aspects of crop production. Weeds constitutes one of the major economic important problem for maize growers and it can reduce yield up to 86 per cent. Manual weeding is the predominant method of control used by smallholder farmers in Africa (Chikoye *et al*., 2002). This method has been found to loosen the soil surrounding the crop rhizosphere and enhances crop growth and yield (Iremiren, 1988). However, this method is time-consuming, labourious and very expensive. Hand weeding one hectare of land cropped to maize may require as much as 25–40 man-days, representing approximately 50–80% of the total labour budget. Control of weeds in maize is, therefore, very important for obtaining higher productivity. A lot of maize farmers in Nigeria failed to obtained reasonable yield because of their failure to get appropriate varieties that will be suitable to their ecological zones and farming pattern. Maize cultivars and hybrids taking a long time to mature may not suit the situation in Northern Guinea Savannah. Therefore, quick and early maturing hybrids/varieties with high yield are intensely needed. Breeders have developed thousands of maize hybrids, from which one or more can flourish in almost any combination of soil and climate could be found in the farming areas. Hybrids also incorporate favorable qualitative traits to be adapted to diverse environmental conditions, specifically changing the

day length (Azam , 2007). High yielding hybrids and varieties play an important role in high maize production.

Recognizing the significant impact of climatic condition on the rapid spread of maize in the northern Guinea and Sudan savannas of Nigeria, the Maize Program of some National institutes such as the International Institute of Tropical Agriculture (IITA) and Institute for Agricultural Research (IAR) have emphasized the development of maize source populations and cultivars that combine earliness or extra-earliness with moderate levels of resistance to S. *hermonthica* and/or resistance to the maize streak virus (MSV) (adu-Apraku *et al.*, 2010).

Maize varieties have different maturity periods hence, there is need to determine weed control strategies, regimes and frequencies that will be suitable for each variety.

1.6 Objectives of the Study

This study was conducted with the following objectives;

i. to determine the effect of weed control treatments on weed and maize varieties.
ii. to evaluate the performance of different maize varieties under the climatic conditions of Samaru and Mando.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Effect of Weeds on Maize

Weed infestation is supreme importance among biotic factors that are responsible for low maize grain yield. Worldwide maize production is hampered up to 40% by competition from weeds which are the most important pest group of this crop (Tesfay, Amin and Mulugeta 2014). Generally, weeds reduce crop yields by competing for light, nutrients, water and carbon dioxide as well as interfering with harvesting and increasing the cost involved in crop production (Tesfay *et al.*, 2014). Weeds are one of the most important factors in maize production, causing severe yield losses worldwide, with an average of 12.8% when weed control is applied and 29.2% without weed control (Oerke and Steiner, 1996).

A number of weed species compete with corn plant and have been observed to reduce yield as much as 65% with delay in weed control. Weeding in maize after the critical period of weed removal can result in up to 83% losses in grain yield (Ehsas *et al.*, 2016). Weeds reduce maize yield from 33-50% depending upon weed species and density (Sharma *et al*., 2000). Weeds compete with crops for light, moisture, space and plant nutrients and consequently interfere with the normal growth of crops. It is known that there is a critical crop-weed competition period with grain losses reaching between 28 and 100% if weeds are not controlled (Teasdale and Mohler, 2000 and Kumar *et al*., 2017). The yield losses in maize due to weeds range from 40% to 80% as reported by Reddy and Tyagi (2005). Weeds cause significant yield loss worldwide with an average of 12.8% when weed control methods are applied and 37% without any weed control (Oerke and Dehne, 2004).

2.2 Weed Control in Maize

Maize yield is widely affected by weed competition. The reduction in yield due to weed resulted from competition for light, water, nutrition and other potential yield limiting factors (Aluko, 2019). To minimize the weeds losses several methods are available such as mechanical, cultural, biological and chemical control methods. Exhausted by cultural method, farmers are moving towards other alternative methods of weeds control. In this scenario, chemical weed control is the best option. Chemical control method is quick, more effective, time and labour saving method than others. Chemical weeds control method is suggested by many researchers (Johnson *et al*., 1997, Toloraya *et al*., 2001, Khan and Haq, 2004 and Juhl, 2004) however, this method is not environmental friendly and hazards to health and also with passage of time the weeds become herbicide resistant (Fahad, Muhammad, Asif and Tasawer 2015). Reduced herbicide doses, reduce crop injury, hazard of contamination in the ecosystem, herbicide also cause phytotoxicity (Pannacci and Covarelli, 2009). Herbicides weed control is an important alternative to manual weeding because it is cheaper, faster and gives better weed control (Kumar *et al*., 2017).

2.2.1 Effect of pre-emergence herbicide atrazine on maize and weed

Application of pre-emergence herbicide during early growth stages followed by post-emergence weed control measures resulted in reduced crop-weed competition and markedly improved the weed control efficiency which subsequently produced higher grain yield in maize (Pandey *et al*., 2001). A prominent triazine herbicide, is currently one of the most widely used herbicides in world of agriculture. It is a selective pre-emergence for control of many broadleaf weeds and grasses in corn, sorghum, sugarcane, pineapple, turf and orchards. This herbicide provides only a narrow spectrum weed control in maize (Patel *et al.*, 2006).

Abdullahi, Ghosh and Dawson (2016) conducted a research and found that pre-emergence application of Atrazine at 1.00 kgha^{-1} + one hand weeding at 45 DAS was found to be the best and economic method for obtaining highest corn yield of about (8.79 t ha^{-1}) as compared with other treatment. Aladesanwa and Adejoro (2009) when in their research found that atrazine at 3.0 and 4.0 kg a.i. ha^{-1} provided effective weed control and significantly ($p<0.05$) increased maize grain yield over the weedy control at a similar level with the weed-free control, but proved completely ineffective at 1.0 and 2.0 kg a.i. ha^{-1}. Deshmukh *et al.,* (2014) reported that the atrazine 1.0 kg ha^{-1} as PE *fb* mechanical /HW at 30 DAS proves better in controlling weed, dry matter accumulation, weed control efficiency, grain yield and net monetary returns. Kumar *et al.,* (2012) opined that atrazine 1.0 kg ha^{-1} + pendimethalin 0.5 kg ha^{-1} (PE) *fb* 2,4-D 0.75 kg ha^{-1} (PoE), *fb* atrazine 1.5 kg ha^{-1} (PE) *fb* atrazine 0.75 kg ha^{-1} (PoE) could be the better alternatives to HW in managing different flushes of weeds in maize.

Application of atrazine 1.5 kg ha^{-1} recorded grain yield of 44.48 kg ha^{-1} which was at par with atrazine at 0.7 kg ha^{-1} and pendimethalin 1.0 kg ha^{-1} and 9.94 per cent higher yield than pendimethalin 1.5 kg ha^{-1}. This is because of the herbicides prevented the germination of weed and reduced the growth of weed (Samanth *et al.,* 2015). Chhetri *et al.,* (2014) found that atrazine at the dose of 1.1 kg ha^{-1} can be applied in maize safely as PoE application treatment for effective control of weeds. Higher grain yield of (5,173 kg ha^{-1}) was achieved in atrazine 1.0 kg ha^{-1} *fb* atrazine 1.0 kg ha^{-1} treated plot (Ahmed and Susheela, 2012). Kumar *et al.,* (2012) reported that pendimethalin 1.5 kg ha^{-1} PE *fb* atrazine 0.75 kg ha^{-1} PoE, atrazine 1.5 kg ha^{-1} PE *fb* atrazine 0.75 kg ha^{-1} PoE were all effective in reducing total weed dry weight as compared to untreated check at harvest.

2.2.2 Effect of Post-emergence Herbicide (Nicosulfuron) on Maize and weed

Nicosulfuron is a sulfonylurea herbicide that exhibits good selectivity on field corn and is highly active on many grass weeds and some broadleaf weeds that interfere with corn (O'Sullivan, Sikkema and

Thomas, 2000). Nicosulfuron controls annual grasses, perennial grasses as well as the broadleaf weeds, redroot pigweed (*Amaranthus retroflexus*) and Pennsylvania smartweed (*Polygonum pensylvanicum* L.) (Kapusta *et al.* 1994). Nicosulfuron is registered as a postemergence herbicide for weed control in field corn in North America and acts by inhibiting the enzyme acetolactate synthase. Nicosulfuron was first introduced into the U.S. corn market in 1990. Acceptance has been rapid and it is now the most commonly used postemergence herbicide for grass control in corn (Forcella and Banken 1996). Nicosulfuron provides a new alternative for control of several troublesome weeds in sweet corn. Like other sulfonylurea herbicides, nicosulfuron is active at low application doses (25 g ha^{-1}), has low potential for ground water contamination and low mammalian toxicity, resulting in minimal impact on the environment, all characteristics that are desirable for herbicides used in integrated weed management programs for sweet corn (O'Sullivan *et al.*, 2000).

Rani, *et al.,* (2011) reported that application of sulfosulfuron 15 g ha^{-1} + imazethapyr 25 g ha^{-1} at PE with HW at 40 DAS was found to be effective and economic weed management practice for irrigated sweet corn. According to Armindo *et al*. (2019) spraying of nicosulfuron herbicide to suppress the forages growth in intercropping with maize resulted in significant ($P<0.01$) increase in grain weight per ear (GWE) and maize grain yield (MGY). The lowest weed density was recorded in plot treated with hand weeding and hoeing followed by Nicosulfuron whereas the maximum was recorded in weedy check. Like density, dry weight of weeds the minimum was observed in hand weeding and hoeing followed by Nicosulfuron (Tesfay *et al.,* 2014). Application of nicosulfuron herbicide (at rate of 6 g a.i. ha^{-1}) did not affect grain yield because it did not kill the forage grass species in intercropping with maize (Armindo *et al*., 2019). According to Fariba *et al.* (2013) Nicosolfuron+hoe weeding decreased weed field bind weed dry weight as compared to Weedy check treatment by 77.78 % and decreased weed Field bindweed density as compared to weedy check treatment by 91.66%.

2.3 Effect of Hoe Weeding on Maize and Weed

Weeds constitutes one of the major economic important problem for maize growers and it can reduce yield up to 86 per cent. Manual weeding is the predominant method of control used by smallholder farmers in Africa (Chikoye *et al*., 2002). This method has been found to loosen the soil surrounding the crop rhizosphere and enhances crop growth and yield (Iremiren, 1988). However, this method is time-consuming, labourious and very expensive. Hand weeding one hectare of land cropped to maize may require as much as 25–40 man-days, representing approximately 50–80% of the total labour budget (Chikoye *et al*., 2002; Darkwa *et al.,* 2001).

No doubt cultural methods are still useful tools but are laborious, time consuming and getting expensive. Moreover, the labour problem is becoming acute day by day and it will not be possible and economical to stick the traditional cultural weed control practices (Oreck and Dehne, 2004; Oerke, 2005) but to some extent Kandasamy and Chandrasekhar (1998) reported that the traditional (non-chemical) method of weed control effectively minimized weed competition and maximized maize yield. Stanzen *et al.,* (2016) observed that 2 hand weeding (HW) recorded significantly higher number of grains cob-, 1,000-grain weight and grain yield which was statistically at par with atrazine 1 kg ha^{-1}. Samanth *et al.,* (2015) reported maximum grain yield in farmer's practice (HW at 20 and 40 DAS) and was *fb* atrazine @ 1.0 kg a.i ha^{-1} as PE *fb* HW at 30 DAS. Pathak *et al.,* (2015) reported that hoeing at 20 DAS *fb* atrazine 0.50 kg ha^{-1} being at par with 2 HW (20 and 40 DAS), registered significantly higher weed control efficiency (WCE) at all growth stages of maize.

Swetha (2015) reported that HW at 20 and 40 DAS recorded higher grain yield (6580 kg ha^{-1}) which was on par with topramezone + atrazine @ 25.2 + 250 g a.i ha^{-1} as PoE (6436 kg ha^{-1}). Stover yield and harvest index was also higher in HW at 20 and 40 DAS (Anwesh, Debasis, Everest, Kousik and Pijush, 2018). Hoeing at 15 DAS controlled the growth of all weed species and their population at 30 DAS was

less than half (23-32 weeds m^{-2}) compared with no inter-culture (67-70 weeds m^{-2}). Earthing up at 30 DAS resulted in the virtual elimination of weeds throughout the crop growth period (Sharma *et al.*, 2000). In the hand hoe system, weeding alone accounts for 40-54% of the total labor input in farming in Ethiopia, Ghana, Malawi, Nigeria, Sierra Leone, Tanzania and Zambia, requiring 300-400 man-hours per hectare (Tesfay *et al.*, 2014).

2.4 Response of Different Maize Varieties to Different Weed Control

There are many weed control methods such as cultural, biological, mechanical and chemical methods which affect different maize varieties. For example, Nyasha *et al.* (2018) found that there was a significant difference ($p<0.05$) among weed control methods. The highest plant height was observed in hand hoeing on inbred line NAW5885 which recorded 29.1cm. According to Nyasha *et al.*, (2018) there was also significant difference ($p<0.05$) among maize inbred lines. Inbred lines CML312, CML444, CML443 and CML00003 were tolerant; they recorded the highest plant height on metolachlor + atrazine + nicosulfuron + halosulfuron herbicide combination. Stefanovic *et al.* (2010) also found that herbicides affect plant height of inbred lines. Akter *et al.* (2021) discovered that at 40 and 80 DAS the parameter was not significant between varieties. The maximum leaf number $plant^{-1}$ (4.75, 11.04, 12.5 and 13.29 at 40, 60, 80 DAS and at harvest respectively) was recorded from V2 and the lowest result was obtained from V1. Ullah *et al.* (2017) found that the number of leaves in the modern varieties differed from 11.66 to 13.66 $plant^{-1}$ with a mean value of 12.88 $plant^{-1}$.

Akter *et al.* (2021) found that variety have a significant effect on plant height at all stages except 80 DAS and harvest stage. In all four stages (40, 60, 80 DAS and at harvest) V2 showed the highest plant height (85.63 cm, 121.38 cm, 172.75 cm and 203.68 cm at 40, 60, 80 DAS and at harvest respectively) over V1. With regards to grain yield, the result found by Khan *et al.* (2016) shows significant results regarding biological yield of maize as affected by different maize hybrids and herbicides application.

The maize hybrid P-3025 produced the highest biological yield (8.90-ton ha^{-1}) and the lowest biological yield (6.49-ton ha^{-1}) was obtained from hybrid P-32T78. Similarly, the herbicide averages demonstrated that 960g/L S metolachlor gave the highest (9.04-ton ha^{-1}) biological yield of maize. However, the lowest biological yield (5.418-ton ha^{-1}) was obtained from weedy check.

Based on yield of Maize response to different weed control, Khan *et al.* (2016) found that for hybrids averages the maximum grain yield (2.25-ton ha^{-1}) was recorded in hybrid P-3025 followed by P-3203, while the minimum grain yield (1.63-ton ha^{-1}) was seen in plots sown with hybrid P-32T78. In similar studies, Hassan (2010) observed that hybrids significantly differ from each other in terms of yield due to differences in genetic makeup. In another similar study Nadeem *et al.* (2006) concluded that the grain yield of maize crop was increased with the use of herbicides as the herbicide application quickly suppresses the weeds germination and ultimately provides a competition free environment for the crop plant to get all the available resources alone. Nyasha *et al.*, (2018) found that the highest grain yield was observed in inbred line CZL0610 in hand hoeing weed control method. On the number of cobs per plant Mohamed *et al*. (2020) discovered that the effect of weed management on number of cobs per plant varied significantly among treatments at 1% probability level. The highest number of cobs per plant (3.84) was found in four hand weeding tracked insignificantly by Nicosulfuron at 2 L ha^{-1}(3.42), three hand weeding (3.33) and one hand weeding (3.17) while two hand weeding produced (2.75) which is statistically similar to that of control treatment (1.84). Stefanovic *et al*., (2010) found that a lag in development stages on inbred lines might have posed an effect on the final grain yield. Susceptible inbred lines CML488, CZL03014, L917 and N3.2.3.3 had the lowest final yield while CML395, CZL0610, CZL00003 and NAW5885 had the medium; CML312, CML444, CML443 and CZL00001 had the highest final grain yield. Herbicides had an effect on growth parameters which later affected the final yield.

Based on harvest index, Akter *et al.* (2021) found that there was no significant statistical difference between varieties regarding harvest index. V2 showed the maximum harvest index (55.85%) over V1 (53.06%). The maximum was harvest index obtained from PSC-121 (V2)

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Experimental Sites

Field trials were conducted during the 2020 rainy season at the Research Farms of the Institute for Agricultural Research, Samaru Zaria (11^0 11' N, 7^0 38' E and 686m above sea level) and College of Agriculture and Animal Science, Mando, (7.43^0N, 8.33^0E and 632m above sea level) located in kaduna all in Northern Guinea Savanna Ecological Zone of Nigeria.

3.2 Meteorological Data

Record of temperatures (maximum and minimum) relative humidity and sunshine hours for the period of the trial 2020 rainy season, were obtained from the Institute for Agricultural Research (IAR) meteorological units at Samaru Zaria and College of Agriculture and Animal Science, Mando Kaduna. The results are shown in Appendices1 and 11.

3.3 Soil Sampling

Soils samples were randomly collected prior to land preparation using soil auger of 9 cm diameter at a depth of 0-30 cm at five point across the experimental sites. The samples collected were bulked, dried, ground, sieved using 2 mm sieve and A composite sample was taken and analyzed for physical and chemical properties. (Black, 1965)

3.4 Treatment, Experimental Design and plot size

The treatments consisted of six (6) weed control treatments Atrazine at 2.0 Kg ai ha^{-1} (applied pre-emergence), Atrazine 2.0 Kg ai ha^{-1} pus hoe weeded at 6 WAS, Nicosulfuron at 0.7 kg ai ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1} + hoe weeded at 6 WAS, 2 hoe weeded at 3 and 6 WAS and weedy

check) and three varieties of maize (SAMMAZ 17, SAMMAZ 29 and SAMMAZ 54). The treatment factors were combined and laid out in randomized complete block design (R C B D) in split plot design arrangement. The weed control treatments were assigned to main plot, while the varieties were assigned subplots and replicated four times. The gross plot consisted of 4 ridges each measured 4m long and 3m wide ($4m \times 3m = 12m^2$) while the net plot was taken from two inner ridges $1.5m \times 1.5m = 2.25m^2$ constituted the net plot.

3.5 Varietal Description

3.5.1 SAMMAZ 29

SAMMAZ 29 was released in 2009 by the International Institute for Tropical Agriculture (IITA). It is an open pollinated and a pedigree of TZE – W Pop DT STR C3. It is adapted to lowland tropics, a very early maturing and the grain colour is white. It takes 57 days to silk with a plant height of 170 cm. It is tolerant to *Striga hermonthica* and resistant to Maize Streak Virus. Seed is large and dented. Cob is large with good husk cover. It matures between 80-85 days. The potential yield is 4.0 tonnes/ha. The outstanding characteristics are extra early maturing drought escaping and Striga tolerant.

3.5.2 SAMMAZ 17

SAMMAZ 17 formally known as Acr Sakatifu C4 was released in 2009 by the Institute for Agricultural Research (IAR), Ahmadu Bello University (ABU), Zaria in Kaduna State of Nigeria. It is an open pollinated and S1 selection from QPM germplasm. SAMMAZ 17 is adapted to lowland tropics, white grain colour, large seed and good seed quality, tolerant to Striga and a medium maturing at 58 days to mid-silking with 220 cm in height with white seeded kernel. Maturity ranges from 90 – 95 days and the potential yield is 5.0 tonnes/ha.

The ecology is Sudan Savanna and transition zones between Sudan and Northern Guinea Savanna.

3.5.3 SAMMAZ 54

SAMMAZ 54 is extra early maturing variety (80-85) days,high grain yield, tolerant to drought and *striga hermonthica*, white in colour. It has a potential yield of 7.2 tonnes. ha^{-1} and adapted all savanna.

3.6 Cultural Practices

3.6.1 Land preparation

The experimental area was harrowed to a fine tilth and ridged 75cm apart. The land was then marked in to plots and replications. A space of 0.5m between plots and 1.5m between replicates was maintained for assessing plots.

3.6.2 Sowing

Sowing was done on 4th July,2020 at Samaru and 9th July,2020 at Mando. The seeds were sown manually at rate of two seeds per hole at the depth of 3cm and spacing of 75cm×25cm. The emerged seedlings were later thinned down to one plant per stand at two weeks after sowing.

3.6.3 Herbicide application and weeding

The pre-emergence herbicide (atrazine at 2.0 Kg per hectare) was applied immediately after sowing while Nicosulfuron at 0.7 kg a.i ha^{-1} was applied 3 WAS. The equipment used was CP3 knapsack sprayer fitted with a green deflector nozzle and set at a pressure of 2.1 kg m^2 to deliver 250L per hectare of spray solution. The spraying was done in the morning when the weather was calm to avoid drift. Hoe weeding was done manually using hoe according to treatment basis at 3 and 6 WAS respectively.

3.6.4 Fertilizer application

Recommended rate of 90kg N, 45 kg P_2O_5 and 45 kg of K_2O per hectare for extra early varieties was split applied. The half dose of N and whole of P and K were applied at 3 WAS using NPK 15:15:15 to supply 45,45,45 kg of N, P_2O5 and K_2O respectively. The remaining half of N kg ha^{-1} second dose was applied 6 WAS using urea (46%N) as source. The recommended rate of 120 kg N, 60 kg P_2O5 and 60 kg K_2O for medium maturing variety was split applied. The half dose of N and the hole of P and K was applied at 3WAS using NPK 15:15:15 to supply 60,60,60 kg of N, P_2O5 and K_2O respectively. The remaining half of N kg. ha^{-1} second dose was applied 6WAS using urea (46%N) as source. Application was by placement at about 3cm depth and 5-8 cm away from the plant.

3.6.5 Pest and disease control

There was incidence of insect pest infestation (stem borer) at 5-6 WAS at both locations and it was treated with application of mixture of cypermethrim+ dimethoate at the rate of 1.0 L ha^{-1} to control the pest.

3.6.6 Harvesting and threshing

Harvesting was done when the plants had attained physiological maturity as the cobs turn yellowish – brown and grains have hardened. The cobs were sundried, weighed and later threshed and winnowed to obtain clean grain.

3.7 Observations and Data Collection

3.7.1 Weed parameters

3.7.1.1 Weed cover score

Weed cover score were taken at 4, 8 and 12 WAS by visual scoring using a scale of 1-9. Where, 1=represents no weed infestation and 9=represent complete weed cover.

3.7.1.2 Weed dry weight (g m^{-2})

Samples of weeds were collected from 50 × 50 cm quadrant area at random in each plot and was done at 4,8 and 12 WAS. The weed was removed, cleaned free from soil and oven dried at 70^{o}C to a constant weight and thereafter weighed for dry matter determination using a mettler balance Toledo SB 16001 model.

3.7.1.3 Weed density

Weeds count were taken from a 50×50 cm quadrant area at random in each plot at 4,8 and 12 WAS. The uprooted weed sample were classified by species and counted to obtain the density of individual weed species. The sum of all species recorded at each sampling time was taken as total density.

3.7.1.4 Weed control efficiency

Was calculated using the following formula:

$$WCE = \frac{\text{Weed dry weight in weedy check - Weed dry weight per treatment}}{\text{Weed dry weight in weedy check}} \times \frac{100}{1}$$

(DAS, 2008)

3.7.2 Crop Parameters

3.7.2.1 Crop vigor score

Crop vigor score was assessed visually at 4, 8 and 12 WAS using a scale of 1 to 9, where scale 1 was given to a plot with completely dead plants, while scale 9 was given to the most vigorous plant. The assessment features used for scoring the plants were height, leaf spread, thickness of the stem and greenness of the leaves.

3.7.2.2 Plant height (cm)

Plant height was measured from the base of each plant to the tip of the highest growing point from each of five tagged plants using a graduated meter rule and the values were recorded at 4, 8 and 12 WAS. The average height was then recorded for each plot.

3.7.2.3 Number of leaves plant^{-1}

This was determined by counting the total number of fully expanded leaves on the tagged plants for each plot at 4, 8 and 12 WAS and the average was taken and recorded.

3.7.2.4 Leaf area index (LAI)

The leaf area index (LAI) of a canopy is the total area of a plant material per unit area occupied by plant. LAI is the ratio of leaf surface area per unit land surface. Non –destructive LAI measurement was employed for each treatment at 4, 8 and 12 WAS using Ceptometer (LP-80) model. The sensor of the Ceptometer was placed diagonally across the two inner rows, such that the end of the sensor coincides with the line of the plants in each row. The displayed LAI for each plot was taken twice and the average was recorded accordingly. All LAI measurements were made under cloud free conditions between 12:00 and 14:00 hours.

3.7.2.5 Shoot dry matter plant^{-1}

Total dry matter per plant in grams was determined by sampling five plants per plot and oven drying at (70^0C) to a constant weight and thereafter weighed using a Mettler Balance Toledo SB 16001 model and the mean were recorded in g plant^{-1}. This was taken at 4, 8 and 12 weeks after sowing.

3.7.2.6 Crop growth rate (CGR)

The crop growth rate of a plant at instance in time is defined as the increase in plant material per unit of time and is expressed in g.m^{-2} wk^{-1}. Crop growth rate (CGR) at various stages was calculated and recorded at 4-8 and 8-12.

$$CGR = \frac{W_2 - W_1}{t_2 - t_1} \text{ g. m}^{-2} \text{ wk}^{-1}$$

Where W_1 and W_2 are the total dry weights in grams/plant at consecutive harvests over a time interval T_2 and T_1 in weeks, respectively

3.7.2.7 Relative growth rate (RGR)

The relative growth rate of a plant at instance in time is defined as the increase in plant material per unit of plant material present per unit of time and is expressed in g g^{-1} wk^{-1}. Relative growth rate (RGR) at various stages was calculated and recorded at 4-8 and 8-12 WAS as suggested by Radford (1967).

$$RGR = \frac{1n\ W_2 - 1n\ W_1}{t_2 - t_1} \quad g.\ g.\ wk\text{-}1$$

Where 1n =Natural log, W1 = Dry weight of plant (g) at time t1, W_2= Dry weight of plant (g) at time t_2.

3.7.2.8 Number of days to 50% tasseling

The number of days from sowing to the time when 50% of the plants per plot have tasseled were counted and recorded.

3.7.2.9 Number of days to 50% silking

The number of days from sowing to the time when 50% of the plants per plot silked were counted and recorded.

3.7.2.10 Number of cobs per plot

The number of productive cobs were counted from the net plot and the total number was recorded.

3.7.2.11 Cobs weight per plot

The harvested cobs from net plot were weighed using a Mettler Balance Toledo SB 16001 model and values were recorded.

3.7.2.12 Length of cob (cm)

The length of five randomly taken cobs was measured using meter rule and the averages was recorded.

3.7.2.13 Diameter of cob (cm)

The diameter of five randomly taken cobs was measured using vernnier caliper and the averages was recorded.

3.7.2.14 Number of kernel rows per cob

The number of kernel rows per cob of the five selected cobs in each net plot and the average was thereafter calculated and recorded.

3.7.2.15 100- grains weight

A randomly selected 100 grains were collected from each net plot and weighed using a Mettler Toledo SB 16001 weighing balance and the values were recorded.

3.7.2.16 Harvest index (HI)

HI was determined and recorded by dividing the grain yields by the total biomass in each net plot.

$$\text{Harvest Index} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

3.7.2.17 Threshing percentage (%)

The percentage was obtained using the following formula:

$$\text{Threshing \%} = \frac{\text{Grain weight after threshing}}{\text{Unshelled cob weight}} \times \frac{100}{1}$$

3.7.2.18 Grains yield in tonne per hectare

The grains obtained after threshing and winnowing from each net plot were weighed using a Mettler Toledo SB 16001 weighing balance and later converted in tonne ha^{-1}.

3.8 Statistical Data analysis

The data collected were subjected to statistical analysis using General Linear Model (GLM) procedure of the Statistical Analysis Software (SAS) package version 9.4. The treatments means were compared using Duncans Multiple Range Test (DMRT) (Duncan,1955) at 5% level of probability. The magnitude and type of relationship between the various parameters were determined by simple correlation analysis (Little and Hills,1978).

CHAPTER FOUR

4.0 RESULTS

4.1 Physical and Chemical Properties of Experimental Sites

Details of physical and chemical properties of soils at experimental sites during 2020 rainy season is shown on Table 4.1 At Samaru, the result shows that, the textural class was sandy loam, pH in water was moderately acidic (5.65), total nitrogen (2.10 g kg^{-1}) and organic carbon (18.16 g kg^{-1}) were high, while available phosphorus (17.16 g kg^{-1}), calcium (2.98 cmol kg^{-1}) magnesium (0.56 cmol kg^{-1}), potassium (0.16 cmol kg^{-1}), sodium (0.21 cmol kg^{-1}) and cations exchange capacity (4.13 cmol kg^{-1}). were medium. At Mando, the textural class was loamy, pH in water was slightly acidic (6.05), organic carbon was higher (17.10 mg kg^{-1}). Total nitrogen (1.86 g kg^{-1}), available phosphorus (10.13 mg kg^{-1}), calcium (3.16 cmol kg^{-1}) magnesium (0.16 cmol kg^{-1}), potassium (0.13 cmol kg^{-1}), sodium (0.22 cmol kg^{-1}) and cation exchange capacity (4.37 cmol kg^{-1}) were medium.

2 Weed Cover Score

The significant effect of weed control treatments and maize varieties on weed cover score of maize during 2020 rainy season at Samaru and Mando is shown in Table 4.2 The effect of weed control treatments on weed cover score was significant across all the sampling periods at both locations. At 4 WAS, at Samaru plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly recorded least weed cover score but statistically similar to plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} and it was followed by hoe weeded at 3 and 6 WAS, Atrazine at 2.0 kg ai ha^{-1} and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 3 and 6 WAS. The weedy check recorded the highest weed cover score. However, at 8 WAS, at in Samaru plots that received

Table 4.1: Physical and chemical properties of soil sample for Samaru and Mando during the 2020 rainy season

	Soil Depth (0-30cm)	
Particle size distribution (g kg^{-1})	Samaru	Mando
Sand	660	510
Silt	180	340
Clay	160	150
Textural class	Sandy Loam	Loamy
Chemical composition		
pH in water (1:2.5)	5.65	6.05
pH in 0.01M$CaCl_2$ (1:2.5)	4.95	5.10
Organic carbon (g kg^{-1})	18.16	17.10
Total nitrogen (g kg^{-1})	2.10	1.86
Available phosphorus (mg kg^{-1})	17.16	10.13
Exchangeable bases (cmol kg^{-1})		
Calcium (Ca)	2.98	3.16
Magnesium (Mg)	0.56	0.68
Pottasium (K)	0.16	0.13
Sodium (Na)	0.21	0.22
Cation Exchange Capacity (C.EC)	4.13	4.37

Analysed at the Department of Agronomy, Ahmadu Bello University, Zaria. (2020)

Nicosulfuron at 0.7 kg ai ha^{-1} and supplementary hoe weeded at 6 WAS significantly produced least weed cover score but statistically similar with plots that received Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3 and 6 WAS, it was however followed by plots that are treated with Atrazine at 2.0 kg ai ha^{-1} and Ncosulfuron at 0.7 kg ai ha^{-1}. The weedy check consistently produced the highest weed covers core, at 12 WAS in Samaru and 4 WAS in Mando all the weed control treatments significantly produced similar weed cover score with exception of plots weeded twice at 3 and 6 WAS and weedy check that produced higher weed cover score. At 8 WAS at Mando plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS produced least weed cover score, it was however followed by plots that received Atrazine at 2.0 kg ai ha^{-1} with supplementary hoe weeding at 6 WAS, plots weeded twice at 3 and 6 WAS and Ncosulfuron at 0.7 kg ai ha^{-1}. The weedy check recorded the highest weed cover score. However, at 12 WAS in Mando all weed control treatments produced similar weed cover score except the weedy check that recorded the highest.

The response of variety on weed cover score was only significant at 4 WAS at Samaru were plots that received SAMMAZ 17 produced the highest weed cover score but was statistically comparable to SAMMAZ 29 and at par with SAMMAZ 54.

The interaction between variety and weed control treatment was significant at Samaru at 4 WAS and is shown on Table 4.2a: Where weedy check in combination with SAMMAZ 17 recorded significantly higher weed cover score which was similar statistically to plots treated with SAMMAZ 54 and weedy check. The least weed cover score was observed when SAMMAZ 29 is combined with Atrazine at 2.0 kg a.i ha^{-1}, Atrazine at 2.0 kg a.i ha^{-1} with hoe weeding at 6 WAS, Nicosulfuron at 0.7 kg a.i ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1} with hoe weeding at 6 WAS which are similar statistically to SAMMAZ 54 with hoe weeding at 3 and 6 WAS.

Table 4.2: Effect of Weed Control Treatments and Variety on Weed Cover Score in Maize during 2020 rainy season at Samaru and Mando.

	Weed Cover Score.					
	Samaru			Mando		
Treatments	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg a.i ha^{-1}	2.67b	3.67b	2.92b	2.92b	4.25b	2.25b
Atrazine at 2.0 kg a.i ha^{-1} + hoe weeding at 6 WAS	2.42b	2.17cd	2.00b	2.00b	1.75d	2.33b
Nicosulfron at 0.7 kg a.i ha^{-1}	2.17bc	2.83bc	1.75b	1.75b	2.75c	2.33b
Nicosulfron at 0.7 kg a.i ha^{-1} + hoe weeding at 6 WAS	1.83c	1.75d	1.92b	1.92b	1.00e	2.17b
Hoe weeding at 3 & 6 WAS	2.58b	2.17cd	2.83a	2.83a	1.75d	2.25b
Weedy check	4.42a	5.08a	3.00a	3.00a	4.92a	3.00a
SE±	0.190	0.290	0.060	0.240	0.070	0.160
Variety (V)						
SAMMAZ 17	2.29a	3.04	2.58	2.58	2.79	2.50
SAMMAZ 29	2.75ab	3.00	2.29	2.29	2.71	2.42
SAMMAZ 54	2.83b	2.79	2.33	2.33	2.71	2.25
SE±	0.130	0.211	0.171	0.170	0.050	0.121
Interaction						
W × V	*	NS	NS	NS	NS	NS

.Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
*= Significant at 5% WAS. = Weeks After Sowing, NS = Not significant
SE = Standard Error

Table 4.2a: Interaction between weed control treatments and maize varieties on Weed Cover Score during 2020 rainy season at Samaru

	Variety		
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	2.75c	2.25d	3.00c
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	3.25bc	2.00d	2.00d
Nicosulfron at 0.7 kg ai ha^{-1}	2.00d	1.75d	2.75cd
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	1.75d	2.00d	1.75d
Hoe weeding at 3 & 6WAS	2.75c	2.75c	2.25d
Weedy check	5.00a	3.50b	4.75ab
SE ± 0.32			

means followed by the same letter(s) are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error kg ai ha^{-1} = kilogram active ingredient per hectare

4.3 Weed Density

The weed density in maize varieties as affected by weed control treatments during the 2020 rainy season at Samaru and Mando is presented in Table 4.3 There was significant effect of weed control treatments throughout the sampling period at both locations with the exception of 12 WAS at Mando. At 4 WAS at Samaru plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} significantly produced least weed density but statistically comparable to plots treated with Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS, hoe weeded at 3 and 6 WAS and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The weedy check plots significantly produced the highest weed density in all sampling periods at both locations except at 12 WAS at Samaru.

At 8 WAS at Samaru, plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS produced least weed density but was statistically similar to plots that received Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS it was followed by plots weeded twice at 3 and 6 WAS, Nicosulfuron at 0.7 kg ai ha^{-1} and Atrazine at 2.0 kg ai ha^{-1}. However, at 12 WAS at Samaru plots that received Nicosulfuron at 0.7 kg ai ha^{-1} significantly produced least weed density but statistically comparable with plots treated with Atrazine at 2.0 kg ai ha^{-1}, hoe weeded at 3 and 6 WAS and weedy check, it was however followed by plots that received Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The highest weed density was recorded in plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. At 4 WAS at Mando plots treated with Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3 and 6 WAS produced the least weed density but statistically similar to plots treated by Nicosulfuron at 0.7 kg ai ha^{-1} and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The highest weed density was recorded in weedy check and plots treated with Atrazine at 2.0 kg ai ha^{-1}. At 8 WAS at Mando, all weed control treatments produced similar weed density with exception of weedy check.

The response of variety to weed control treatments on weed density was only significant at 12 WAS at Mando, where varieties SAMMAZ 29 and SAMMAZ 54 significantly recorded least weed density while, plots with SAMMAZ 17 recorded highest weed density per plot. There was no significant interaction between the factors.

Table 4.3: Effect of Weed Control Treatments and Variety on Weed Density in Maize During the 2020 rainy season at Samaru and Mando.

	Weed density per plot.					
	Samaru			Mando		
Treatment	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg ai ha^{-1}	12.42ab	15.17b	16.00bc	14.17a	14.33b	13.75
Atrazine at 2.0 kg ai ha^{-1} +	12.75ab	10.25cd	19.08ab	10.67b	12.17b	14.25
hoe weeding at 6WAS						
Nicosulfron at 0.7 kg ai ha^{-1}	11.83b	13.17bc	12.67c	12.33ab	12.58b	14.92
Nicosulfron at 0.7 kg ai ha^{-1} +	12.58ab	7.08d	19.75a	12.75ab	11.58b	12.25
hoe weeding at 6WAS						
Hoe weeding at 3 & 6WAS	14.00ab	10.92c	16.42bc	11.17b	12.50b	13.75
Weedy check	14.83a	23.83a	15.33bc	13.83a	23.83a	12.92
SE±	0.91	1.22	1.25	0.86	0.98	1.33
Variety (V)						
SAMMAZ 17	13.13	13.62	17.04	12.46	14.71	16.00a
SAMMAZ 29	12.87	12.75	16.46	12.58	14.50	12.88b
SAMMAZ 54	13.21	13.83	16.13	12.42	14.29	12.04b
SE±	0.64	0.86	0.88	0.61	0.69	0.80
Interaction						
W × V	NS	NS	NS	NS	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant
WAS = Weeks After Sowing
SE = Standard Error

4.4 Weed Dry Weight $12m^{-1}$

Table 4.4 shows the influence of weed control treatment and variety on weed dry weight during 2020 rainy season at Samaru and Mando. Weed control treatments had significant effect on weed dry weight per plot. At 4 WAS at Samaru hoe weeded plots at 3 and 6 WAS and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly produced least weed dry weight but statistically similar to plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS which was followed by plots that received Atrazine at 2.0 kg ai ha^{-1} and Nicosulfuron at 0.7 kg ai ha^{-1}. The weedy check consistently recorded highest weed dry weight in all sampling periods at both locations.

At 8 WAS at Samaru plots treated with Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS, Nicosulfuron at 0.7 kg ai ha^{-1}, hoe weeded at 3 and 6 WAS and Nicosulfuron at 0.7 kg ai ha^{-1} and supplementary hoe weeded at 6 WAS significantly produced least weed dry weight which was followed by plots that received Atrazine at 2.0 kg ai ha^{-1}. However, at 12 WAS at Samaru and 8 WAS at Mando all weed control treatments produced similar weed dry weight with the exception of weedy check that recorded the highest. At 4 WAS in Mando plots treated with Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6WAS and hoe weeded at 3 and 6 WAS significantly recorded the least weed dry weight which was followed by plots that received Atrazine at 2.0 kg ai ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1} and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS.

at Mando at12 WAS plots that received Atrazine at 2.0 kg ai ha^{-1} and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS produced least weed dry weight which was followed plots treated with Nicosulfuron at 0.7 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3 and 6 WAS.

Table 4.4: Effect of Weed Control Treatments and Variety on Weed Dry Weight During 2020 rainy season at Samaru and Mando.

	Weed Dry Weight (g)					
	Samaru			Mando		
Treatment	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg a.i ha^{-1}	7.68bc	21.16b	18.06b	17.12b	11.56b	12.31c
Atrazine at 2.0 kg a.i ha^{-1} + hoe weeding at 6 WAS	4.74d	12.28c	19.03b	7.23c	10.13b	21.41b
Nicosulfron at 0.7 kg a.i ha^{-1}	9.32b	12.97c	14.59b	15.90b	11.56b	29.54b
Nicosulfron at 0.7 kg a.i ha^{-1} + hoe weeding at 6 WAS	5.90cd	11.51c	18.88b	17.89b	6.78b	12.99c
Hoe weeding at 3 & 6 WAS	4.63d	14.17c	16.22b	7.28c	8.33b	22.34b
Weedy check	36.86a	53.83a	65.47a	38.44a	54.11a	69.13a
SE±	0.96	2.40	2.14	1.01	1.56	2.88
Variety (V)						
SAMMAZ 17	4.13	23.73	56.11	16.41	17.93	28.98
SAMMAZ 29	3.91	23.05	53.29	17.88	16.44	24.64
SAMMAZ 54	3.85	22.32	50.92	17.64	16.86	30.25
SE±	0.22	1.28	1.51	0.71	1.10	2.04
Interaction						
W × V	NS	NS	NS	*	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
* = Significant at 5%
WAS = Weeks After Sowing NS=Not significant
SE = Standard Error

The effect of variety on weed dry weight was not significant at both locations at all the sampling period. The interaction between the factors on weed dry weight was significant in Mando at 4 WAS and is shown on Table 4.4a. Plots treated with Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3 and 6 WAS in combination with all the varieties recorded least weed dry weight. However, the highest weed dry weight was observed in combination of weedy check with all the varieties.

Table 4.4a: Interaction between weed control treatments and maize varaities on Weed Dry Weight Per plot during 2020 rainy season at Mando

		Variety	
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	16.3cd	18.60c	16.63c
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	16.15e	7.05e	8.47e
Nicosulfron at 0.7 kg ai ha^{-1}	13.95d	19.70c	14.05d
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	14.17d	18.52c	20.97bc
Hoe weeding at 3 & 6WAS	11.10de	4.30e	6.45e
Weedy check	36.95ab	39.10a	39.28a
SE ±	1.74		

Means followed by the same letter(s) within a row in each treatment group are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error kg ai ha^{-1} = kilogram active ingredient per hectare
g ai ha^{-1} = gram active ingredient per hectare

4.5 Crop Vigour Score.

Table 4.5 shows the effect of weed control and variety on crop vigour score during 2020 rainy season at Samaru and Mando. Weed control treatments had significant effect on crop vigour score.

The effect of weed control treatments on crop vigour score was significant at all sampling period at Samaru and at 8 WAS only at Mando. At Samaru 4 WAS plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} significantly produced higher crop vigour score which was statistically comparable to plots that received Atrazine at 2.0 kg ai ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3 and 6 WAS. The weedy check plots and Atrazine at 2.0 kg ai ha^{-1}plus supplementary hoe weeded recorded the least crop vigour score. However, at 8 WAS at Samaru plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly produced higher crop vigour score but statistically comparable to plots treated Nicosulfuron at 0.7 kg ai ha^{-1} which was followed by plots treated with Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded twice at 3 and 6 WAS. The least crop vigour score was recorded in weedy check.

At 12 WAS at Samaru plots that received Nicosulfuron at 0.7 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly produced higher crop vigour score but statistically similar to plots that received Atrazine at 2.0 kg ai ha^{-1} and hoe weeded at 3 and 6 WAS. The weedy check recorded the least crop vigour score, however at 8 WAS at Mando plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly recorded higher crop vigour score which was followed by plots treated with Atrazine 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS, hoe weeded at 3 and 6 WAS and Nicosulfuron at 0.7 kg ai ha^{-1}. The least was recorded in weedy check plots.

Table 4.5: Effect of Weed Control Treatments and variety on Crop Vigour Score of Maize During the 2020 rainy season at Samaru and Mando.

	Crop Vigour Score.					
	Samaru			Mando		
Treatment	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg ai ha^{-1}	4.33ab	8.25bc	8.42ab	4.50	8.25b	9.00
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	3.83b	8.17bc	8.75a	4.25	8.08b	9.25
Nicosulfron at 0.7 kg ai h^{-1}	4.50a	8.50ab	8.75a	4.25	8.25b	9.00
Nicosulfron at 0.7 kg ai h^{-1} + hoe weeding at 6WAS	4.25ab	8.75a	9.00a	4.50	8.83a	9.00
Hoe weeding at 3 & 6WAS	4.33ab	8.00bc	8.50ab	4.33	8.17b	9.08
Weedy check	3.83b	7.75c	7.83b	4.33	7.422c	8.67
SE±	0.16	0.22	0.25	0.16	0.14	0.21
Variety (V)						
SAMMAZ 17	4.33a	8.50a	9.21a	4.29	8.42a	9.17
SAMMAZ 29	4.38a	8.38a	8.63b	4.29	8.13b	9.04
SAMMAZ 54	3.83b	7.83b	7.79c	4.50	7.96b	8.79
SE±	0.11	0.16	0.17	0.11	0.10	0.15
Interaction						
W × V	NS	NS	NS	NS	NS	*

.Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
* = Significant at 5%
WAS = Weeks After Sowing NS=Not significant
SE = Standard Error

Response of variety on crop vigour score was significant at all sampling period at Samaru and 8 WAS only at Mando. At Samaru at 4 and 8 WAS SAMMAZ 17 and SAMMAZ 29 significantly produced higher crop vigour score which was at par statistically with SAMMAZ 54. However, at 12 WAS in Samaru SAMMAZ 17 significantly recorded vigorous maize plant and was followed by SAMMAZ 29. The least was recorded in plots with SAMMAZ 54. At Mando SAMMAZ 17 recorded higher crop vigour score than (SAMMAZ 29 and SAMMAZ 54) that were similar.

The interaction between the factors on crop vigour score was significant at Mando at 8 WAS and Is shown on Table 4.5a. Plots that received Nicosulfuron at 0.7 kg ai ha^{-1} in combination with SAMMAZ 17 significantly produced higher crop vigour score but statistically similar to plots weeded twice at 3 and 6 WAS in combination with SAMMAZ 54 while the lowest was recorded in plots with weedy check together with SAMMAZ 54.

Table 4.5a: Interaction between weed control treatments and maize varieties on Crop Vigour Score at Mando 12 WAS during 2020 rainy season

		Variety	
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	8.75 b	9.00 a	9.25 a
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	9.50 a	9.75 a	8.50 b
Nicosulfron at 0.7 kg ai ha^{-1}	9.00 a	8.75 b	9.25 a
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	9.50 a	9.00 a	8.50 b
Hoe weeding at 3 & 6WAS	8.50 b	8.50 b	9.00 a
Weedy check	9.75 a	9.25 a	8.25 b
SE ± 0.35			

Means followed by the same letter(s) within a row in each treatment group are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error kg ai ha^{-1} = kilogram active ingredient per hectare
. g ai ha^{-1} = gram active ingredient per hectare

4.6 Weed Control Efficiency

Table 4.6 present the effect of weed control and variety on weed control efficiency of maize during 2020 rainy season at Samaru and Mando. The effect of weed control treatments on weed control efficiency was significant in all sampling periods at both locations. At 4 WAS at Samaru plots weeded twice at 3 and 6 WAS and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly had higher weed control efficiency but statistically comparable to plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS which was followed by Atrazine at 2.0 kg ai ha^{-1} and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The weedy check consistently had the least weed control efficiency throughout the sampling period at both locations. However, at 8 WAS at Samaru plots that received Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS, Nicosulfuron at 0.7 kg ai ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3 and 6 WAS significantly produced higher weed control efficiency which was followed by plots with Atrazine at 2.0 kg ai ha^{-1}.

At 12 WAS at Samaru and 8 WAS at Mando all weed control treatments had statistically similar weed control efficiency with the exception of weedy check. At Mando, at 4 WAS plots weeded twice at 3 and 6 WAS and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded 6 WAS significantly recorded higher weed control efficiency which was followed by plots that received Atrazine at 2.0 kg ai ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1}, and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS.

At 12 WAS at Mando plots treated with Atrazine at 2.0 kg ai ha^{-1} and Nicosulfuron plus supplementary hoe weeded at 6 WAS significantly had higher weed control efficiency which was followed by hoe weeded at 3 and 6 WAS, Nicosulfuron at 0.7 kg ai ha^{-1} and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS.

Table 4.6: Effect Weed Control Treatments and Variety on Weed Control Efficiency in Maize during the 2020 rainy season at Samaru and Mando.

	Weeds Control Efficiency					
	Samaru			Mando		
Treatment	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg ai ha^{-1}	79.18bc	60.67b	72.43a	54.43b	78.65a	82.14a
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	87.15a	77.18a	70.94a	81.29a	81.29a	68.93b
Nicosulfron at 0.7 kg ai h^{-1}	74.73c	75.89a	77.72a	58.59b	78.64a	57.12b
Nicosulfron at 0.7 kg ai h^{-1} + hoe weeding at 6WAS	84.01ab	78.61a	71.17a	53.41b	87.46a	80.14a
Hoe weeding at 3 & 6WAS	87.47a	73.67a	75.23a	81.03a	84.61a	67.57b
Weedy check	0.11d	0.05c	0.05b	0.11c	0.02b	0.33c
SE±	2.58	4.47	3.27	2..62	2.88	4.18
Variety (V)						
SAMMAZ 17	70.03	61.64	64.26	57.27	66.87	57.96
SAMMAZ 29	68.03	60.49	57.55	53.44	69.62	64.24
SAMMAZ 54	67.64	60.87	61.97	54.06	68.83	56.10
SE±	1.83	3.16	2.31	1.85	2.03	2.96
Interaction						
W × V	NS	NS	NS	NS	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significan
WAS = Weeks After Sowing
SE = Standard Error

Effect of variety on weed control efficiency was not significant and interaction between the factors is not significant.

4.7 Plant Height

The influence of weed control treatments on plant height of maize varieties during 2020 rainy season at Samaru and Mando is shown on Table 4.7

Weed control treatments had significant effect on plant height at both locations. At 4 WAS at Samaru plots that received Nicosulfuron at 0.7 kg ai ha^{-1} significantly produced taller maize plants it was however statistically comparable to plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS which was followed by hoe weeded at 3 and 6 WAS, Atrazine at 2.0 kg ai ha^{-1} and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The weedy check had the shortest plant. However, at 8, 12 WAS at Samaru and 12 WAS at Mando, all weed control treatments produced statistically similar plant height with exception of weedy check plots that recorded the least.

At 4 WAS at Mando, plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} significantly produced taller plants but statistically comparable to the plots that received Atrazine at 2.0 kg ai ha^{-1} and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS which was followed by plots weeded twice at 3 and 6 WAS and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The weedy check produced the shortest plants. At 8 WAS at Mando, plots that received Nicosulfuron at 0.7 kg ai ha^{-1} significantly recorded taller plant which was followed by other weed control treatments with exception of weedy check plots.

Table 4.7: Effect of Weed Control Treatments and Variety on Plant Height (cm) of Maize during the 2020 rainy season at Samaru and Mando.

	Plant Height (cm)					
	Samaru			Mando		
Treatment	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg ai ha^{-1}	24.85b	154.62a	206.52a	26.57ab	168.73b	219.13a
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	24.98b	157.27a	211.50a	26.92ab	165.83b	215.47a
Nicosulfron at 0.7 kg ai ha^{-1}	27.93a	154.04a	203.70a	28.91a	186.63a	227.58a
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	26.65ab	156.10a	203.65a	25.47b	171.13b	225.07a
Hoe weeding at 3& 6WAS	24.65b	145.20a	197.92a	26.05b	162.67b	216.87a
Weedy check	21.90c	128.35b	166.92b	20.95c	143.60c	162.68b
SE±	0.72	5.25	5.35	0.80	5.21	5.38
Variety (V)						
SAMMAZ 17	25.85a	150.13	202.48	25.16	164.76	206.76
SAMMAZ 29	25.40ab	150.38	201.33	25.97	167.90	215.20
SAMMAZ 54	24.25b	147.28	190.94	26.30	166.64	211.44
SE±	0.51	3.71	4.19	0.57	3.68	3.80
Interaction						
W × V	NS	NS	NS	NS	NS	NS

.Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS =Not Significant
WAS = Weeks After Sowing
SE = Standard Error

Response of variety on plant height was only significant at 4 WAS at Samaru where SAMMAZ 17 significantly produced taller maize plants that were statistically comparable to SAMMAZ 29, The shortest maize plants were recorded in plots with SAMMAZ 54.

There Interaction of the factors on plant height was not significant at both locations.

4.8 Number of leaves

Table 4.8 shows the influence of weed control treatments and variety on number of leaves per plant of maize during 2020 rainy season at Samaru and Mando. There was significant effect of weed control treatments at both locations.

At 4 WAS at Samaru, plots weeded twice at 3 and 6 WAS, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS, Nicosulfuron at 0.7 kg ai ha^{-1} and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly produced higher number of leaves, it was however statistically comparable to plots that received Atrazine 2.0 kg ai ha^{-1}. The lowest number of leaves was recorded in weedy check plots at all sampling period at both locations with the exception of 12 WAS in Mando. At 8 WAS at Samaru plots treated with Nicosulfuron at 0.7 kg ai ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly produced higher number of leaves but statistically similar to Atrazine at 2.0 kg ai ha^{-1} and hoe weeded at 3 and 6 WAS.

At 12 WAS at Samaru plots that received Nicosulfuron at 0.7 kg ai ha^{-1} and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly recorded highest number of leaves but statistically similar to plots treated with Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3and 6 WAS. At Mando at 4 WAS plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS, Atrazine at 2.0 kg ai

Table 4.8: Effect of Weed Control Treatments and Variety on Number of Leaves of Maize during the 2020 rainy season at Samaru and Mando.

	Number of Leaves					
	Samaru			Mando		
Treatment	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg ai ha^{-1}	6.75ab	11.00ab	10.57ab	7.05a	11.73b	9.85
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	7.18a	11.60a	10.65ab	7.05a	11.85b	9.77
Nicosulfron at 0.7 kg ai ha^{-1}	7.00a	11.30a	11.25a	6.93ab	12.47a	9.58
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	7.07a	11.45a	11.28a	7.07a	11.73b	10.10
Hoe weeding at 3 & 6WAS	7.05a	11.23ab	10.75ab	7.05a	11.67b	9.93
Weedy check	6.47b	10.55b	10.38b	6.72b	9.42c	9.4
SE±	0.16	0.23	0.23	0.09	0.14	0.24
Variety (V)						
SAMMAZ 17	7.06	11.51a	10.96a	7.01	11.34	9.78a
SAMMAZ 29	6.92	11.32a	11.18a	6.94	11.63	10.12ab
SAMMAZ 54	6.78	10.74b	10.30b	6.98	11.52	9.43b
SE±	0.11	0.17	0.16	0.07	0.11	0.17
Interaction						
W × V	NS	NS	NS	NS	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant
WAS = Weeks After Sowing
SE = Standard Error

ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3 and 6 WAS significantly produced higher number of leaves but statistically similar to Nicosulfuron at 0.7 kg ai ha^{-1}. However, at 8 WAS, at Mando plots received Nicosulfuron at 0.7 kg ai ha^{-1} significantly recorded

higher number of leaves which was followed by other weed control treatments.

The effect of variety on number of leaves was significant at both location, SAMMAZ 17 and 29 had significantly produced higher number of leaves at 8 and 12 WAS at Samaru while SAMMAZ 54 recorded least number of leaves.

There was significant effect at 12 WAS in Mando in which SAMMAZ 17 produced higher number of leaves but statistically the similar with SAMMAZ 29, but at par with SAMMAZ 54. The interaction of the factors on number of leaves was not significant at both locations.

4.9 Leaf Area Index

Table 4.9 shows the effect of weed control on leaf area index of maize varieties during 2020 rainy season at Samaru and Mando.

The effect of weed control treatments on leaf area index was significant at all the sampling period.

At 4 WAS, at Samaru, all weed control treatments produced statistically similar leaf area index with the exception of plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} that recorded the highest leaf area index. However, at 8 WAS at Samaru plots that received Nicosulfuron at 0.7 kg ai ha^{-1} produced significantly higher leaf area index but was statistically comparable with plots treated Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeding at 6 WAS, Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus

Table 4.9 Effect of Weed Control Treatments and Variety on leave Area Index of Maize during 2020 rainy season at Samaru and Mando

	Leaf Area Index.					
	Samaru			Mando		
Treatment	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg ai ha^{-1}	1.64b	1.89ab	2.14a	1.49b	3.25b	2.29a
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	1.42b	1.91ab	2.08a	1.73ab	3.29b	2.09a
Nicosulfron at 0.7 kg ai ha^{-1}	1.99a	2.34a	2.15a	1.82a	4.49.a	2.52a
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	1.56b	2.15ab	2.15a	1.81a	3.94a	2.55a
Hoe weeding at 3 & 6WAS	1.67b	1.78b	2.10a	1.89a	4.00a	2.34a
Weedy check	1.37b	1.22c	1.38b	1.19c	2.39c	1.47b
SE±	0.12	0.15	0.14	0.09	0.22	0.15
Variety (V)						
SAMMAZ 17	1.71	2.03a	2.12a	1.8a	3.43	2.25ab
SAMMAZ 29	1.61	1.99a	2.29a	1.58b	3.64	2.42ab
SAMMAZ 54	1.48	1.62b	1.59b	1.57b	3.62	1.96b
SE±	0.09	0.10	0.10	0.07	0.17	0.10
Interaction						
W × V	*	NS	NS	**	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)

** = Significant at 1% *=Significant at 5 %

WAS = Weeks After Sowing NS=Not significant

SE = Standard Error

hoe weeding at 6WAS and was followed by plots weeded twice at 3 and 6 WAS. The weedy check recorded the lowest leaf area index.

At 12 WAS at both locations all weed control treatments significantly recorded similar leaf area index with the exception of weedy check. At 4 WAS at Mando plots treated with Nicosulfuron at 0.7 kg ai ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3 and 6 WAS significantly recorded higher leaf area index and was followed by plots that received Atrazine at 2.0 kg ai ha^{-1}. The weedy check plots recorded the lowest. At 8 WAS at Mando, plots treated with Nicosulfuron at 0.7 kg ai ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and hoe weeded at 3 and 6 WAS significantly produced higher leaf area index, it was however followed by Atrazine at 2.0 kg ai ha^{-1} and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The lowest was observed in weedy check plots.

The effect of variety on leaf area index was significant at all the sampling period at both locations except at 4 WAS at Samaru and 8 WAS at Mando. At 8 and 12 WAS at Samaru SAMMAZ 17 and SAMMAZ 29 significantly recorded higher leaf area index which was followed by SAMMAZ 54. At 4 WAS at Mando SAMMAZ 17 recorded higher leaf area index and was statistically at par than SAMMAZ 29 and SAMMAZ 54. However, at 12 WAS at Mando, all the varieties produced similar leaf area index with exception of SAMMAZ 54 that recorded the lowest.

The interaction between weed control and variety on leaf area index was significant at Samaru and is shown on Table 4.9a.

Plots treated with Atrazine at 2.0 kg ai ha^{-1} plus hoe weeding at 6 WAS with all varieties significantly produced higher leaf area index while the lowest was recorded in plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus hoe weeding at 6 WAS with SAMMAZ 29.

Table 4.9a: Interaction between weed control treatments and maize varieties on Leaf Area Index at Samaru during 2020 rainy season

	Variety		
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	1.17b	2.24a	1.52b
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	2.05a	2.01a	1.93a
Nicosulfron at 0.7 kg ai ha^{-1}	1.75a	1.23b	1.25ab
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	1.79a	1.20b	1.69b
Hoe weeding at 3 & 6WAS	1.96a	1.63b	1.24b
Weedy check	1.52b	1.35b	1.24b
SE ±	0.60		

Means followed by the same letter(s) are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error 3. kg ai ha^{-1} = kilogram active ingredient per hectare
g ai ha^{-1} = gram active ingredient per hectare

Table 4.9b: Interaction between weed control treatments and maize varieties on Leaf Area Index at Mando during 2020 rainy season

	Variety		
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	1.45c	1.56c	1.49c
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	1.64bc	1.42c	2.13ab
Nicosulfron at 0.7 kg ai ha^{-1}	1.64c	1.98b	1.85b
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	1.95b	1.93b	1.55c
Hoe weeding at 3 & 6WAS	1.63c	1.38c	2.68a
Weedy check	1.16c	1.20c	1.19c
SE ±	0.16		

.Means followed by the same letter(s) are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error 3. kg ai ha^{-1} = kilogram active ingredient per hectare

Table 4.9b presents the interaction of factors on leaf area index at Mando.

Hoe weeded at 3 and 6 WAS combined with SAMMAZ 54 produced significantly higher leaf area index which was similar to plots that received Atrazine at 2.0 kg ai ha^{-1} plus hoe weeding at 6 WAS with SAMMAZ 54.

The least was recorded in plots that received SAMMAZ 17 together with weedy check.

4.10 Shoot Dry Matter.

The effect of weed control treatments and variety on total shoot dry matter of maize varieties during 2020 raining season at Samaru and Mando is presented at Table 4.10.

The effect of weed control treatments was significant on shoot dry weight at

Samaru at 4 and 8 WAS. At 4 WAS all weed control treatments produced similar shoot dry weight with the exception plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} that recorded the highest shoot dry weight. However, at 8 WAS plots that received Nicosulfuron at 0.7 kg ai ha^{-1} significantly recorded heavier shoot but statistically comparable to plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and was followed by plots weeded twice at 3 and 6 WAS, Atrazine at 2.0 skg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The weedy check recorded the lowest shoo dry weight.

The effect of variety on shoot dry weight was significant at all the sampling period except at 12 WAS in Mando. SAMMAZ 17 produced higher shoot dry weight which was statistically at par with SAMMAZ 29 and SAMMAZ 54 that were statistically comparable in all sampling period.

The interaction between weed control and variety on shoot dry weight was significant at 4 WAS at and presented in Samaru on Table 4.10a. Plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus hoe weeding

Table 4.10: Effect of Weed Control Treatments and Variety on Shoot Dry Weight (g) of Maize during the 2020 rainy season at Samaru and Mando.

	Shoot Dry Weight Per Plant (g)					
	Samaru			Mando		
Treatment	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg ai ha^{-1}	4.18b	23.80bc	56.23	9.88	19.79	52.89
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	4.71b	21.56bc	52.28	10.14	20.12	55.14
Nicosulfron at 0.7 kg ai ha^{-1}	5.93a	30.93a	51.54	10.05	20.14	55.46
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	4.20b	26.46ab	53.74	10.35	20.26	58.23
Hoe weeding at 3 & 6WAS	4.54b	22.91bc	56.93	10.03	21.06	57.60
Weedy check	4.67b	20.34c	61.78	9.77	18.07	56.37
SE±	0.26	1.68	3.39	0.77	1.30	4.37
Variety (V)						
SAMMAZ 17	6.28a	27.63a	62.03a	12.46a	23.32a	61.14
SAMMAZ 29	3.93b	23.05b	53.29b	8.96b	19.28b	53.65
SAMMAZ 54	3.91b	22.32b	50.92b	8.69b	17.11b	53.05
SE±	0.19	1.41	2.40	0.55	0.92	0.97
Interaction						
W × V	**	NS	NS	NS	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
** = Significant at 1%
WAS = Weeks After Sowing NS= Not significant 5. SE = Standard Error

at 6 WAS with SAMMAZ 17 recorded highest shoot dry weight while the lowest was observed in plots that received Atrazine at 2.0 kg ai ha^{-1} with SAMMAZ 29.

Table 4.10a: Interaction between weed control treatments and maize varieties on Shoot Dry Weight during 2020 rainy season at Samaru

	Variety		
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	6.05a	2.73c	3.76c
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	6.33a	4.08b	3.73c
Nicosulfron at 0.7 kg ai ha^{-1}	6.29a	3.04c	3.29c
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	7.09a	3.91b	3.01c
Hoe weeding at 3 & 6WAS	5.13b	3.66c	4.84b
Weedy check	6.82a	6.01a	4.95b
SE ±	0.46		

.Means followed by the same letter(s) are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error 3. kg ai ha^{-1} = kilogram active ingredient per hectare

4.11 Crop Growth Rate ($g.m^{-2}.wk^{-1}$)

Table 4.11 shows the significant effect of crop growth rate as influenced by weed control treatments and variety during 2020 rainy season at Samaru and Mando. The effect of weed control treatments on crop growth rate was only significant at 8 WAS at Samaru.

Plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} significantly recorded higher crop growth rate but statistically comparable to the plots treated with Atrazine at 2.0 kg ai ha^{-1} which was followed by plots that received Nicosulfuron at 0.7kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and Atrazine at

Table 4.11: Effect of Weed Control Treatments and Variety on Crop Growth Rate per plant (C.G.R) of Maize during the 2020 rainy season at Samaru and Mando.

	Crop Growth Rate.			
	Samaru		Mando	
Treatment	8WAS	12WAS	8WAS	12WAS
Weed control (W)				
Atrazine at 2.0 kg ai ha^{-1}	5.57ab	7.44	2.48	8.28
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	4.77bc	7.12	2.49	8.76
Nicosulfron at 0.7 kg ai ha^{-1}	6.25a	7.80	2.53	8.83
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	4.59bc	8.05	2.48	9.49
Hoe weeding at 3 & 6WAS	4.22c	8.51	2.76	9.34
Weedy check	4.03c	7.71	2.07	9.58
SE±	0.38	0.61	0.37	1.11
Variety (V)				
SAMMAZ 17	5.34	8.60a	2.72	9.45
SAMMAZ 29	4.79	7.56ab	2.65	9.14
SAMMAZ 54	4.59	7.15b	2.04	8.44
SE±	0.27	0.43	0.26	0.79
Interaction W × V	**	NS	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
** = Significant at 1%
WAS = Weeks After Sowing NS Not significant
SE = Standard Error

2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. Plots weeded twice at 3, 6 WAS and weedy check recorded the lowest crop growth rate.

The influence of variety on crop growth rate was only significant at 8 WAS Samaru. SAMMAZ 17 significantly recorded higher crop growth rate but statistically comparable to SAMMAZ 29. SAMMAZ 54 recorded the least crop growth rate. The interaction between the factors was significant at Samaru.

Table 4.11a. present the interaction of between factors on crop growth rate at Samaru.

SAMMAZ 29 when combine with weedy check significantly produced higher crop growth rate which was statistically similar to the combination of Atrazine at 2.0 kg ai ha^{-1} and SAMMAZ 54, The lowest was recorded in plots weeded twice at 3, 6 WAS and SAMMAZ 29.

Table 4.11a: Interaction between weed control treatments and maize varieties on Crop Growth Rate during 2020 rainy season at Samaru

	Variety		
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	6.07b	4.26c	6.38b
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	5.54b	3.92c	4.86bc
Nicosulfron at 0.7 kg ai ha^{-1}	5.00b	3.60c	3.49c
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	4.42c	4.17c	4.08c
Hoe weeding at 3 & 6WAS	5.76b	3.87c	4.14c
Weedy check	5.22b	8.89a	4.64c
SE ±	0.66		

Means followed by the same letter(s) are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error 3. kg ai ha^{-1} = kilogram active ingredient per hectare

4.12 Relative Growth Rate ($g.g^{-1}$ wk^{-1})

The influence of weed control treatments and variety on relative growth rate of maize varieties during 2020 rainy season at Samaru and Mando is shown in Table 4.12. Effect of weed control treatments on relative growth rate was only significant **a**t 8 WAS in Samaru. Plots that received Nicosulfuron at 0.7 kg ai ha^{-1} significantly produced higher relative crop growth rate but comparably statistically with Atrazine at 2.0 kg ai ha^{-1} was followed by plot treated with Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeding at 6 WAS, hoe weeding at 3 and 6WAS and Nicosulfuron at 0.7kg ai ha^{-1} plus supplementary hoe weeding at 6 WAS. The weedy check recorded the least relative growth rate.

The influence of relative growth rate on variety was significant at Samaru and 8 WAS at Mando. At Samaru in all the sampling period, SAMMAZ 17 significantly produced higher relative growth rate which is at par statistically with SAMMAZ 29 and SAMMAZ 54. However, at Mando SAMMAZ 17 and SAMMAZ 29 recorded the highest relative growth rate while the least was observed in plot with SAMMAZ 54.

The interaction between the factors on relative growth rate was significant at 8 WAS at Samaru and is shown in table 4.12a The highest relative growth rate was recorded when weedy check was combined with SAMMAZ 29 while the lowest was observed in plots that received Nicosulfuron at 0.7 kg ai ha^{-1} with SAMMAZ 54 and 29.

Table 4.12: Effect of Weed Control Treatments and Variety on Relative Growth rate per plant (R.G.R) of Maize during the 2020 rainy season at Samaru and Mando.

	Relative Growth Rate.			
	Samaru		Mando	
Treatment	8WAS	12WAS	8WAS	12WAS
Weed control (W)				
Atrazine at 2.0 kg ai ha^{-1}	1.39ab	1.73	1.28	1.71
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	1.36bc	1.71	1.29	1.72
Nicosulfron at 0.7 kg ai ha^{-1}	1.47a	1.69	1.29	1.73
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	1.30bc	1.71	1.29	1.75
Hoe weeding at 3 & 6WAS	1.33bc	1.70	1.30	1.74
Weedy check	1.29c	1.78	1.23	1.74
SE±	0.03	0.03	0.03	0.03
Variety (V)				
SAMMAZ 17	1.43a	1.79a	1.35a	1.77
SAMMAZ 29	1.32b	1.71b	1.27a	1.71
SAMMAZ 54	1.32b	1.69b	1.21b	1.71
SE±	0.02	0.02	0.02	0.02
Interaction				
W × V	*	NS	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
* = Significant at 5%
WAS = Weeks After Sowing NS=Not Significant
SE = Standard Error

Table 4.12a: Interaction between weed control treatments and maize varieties on Relative Growth Rate during 2020 rainy season at Samaru.

	Variety		
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	1.47a	1.27b	1.45a
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	1.45a	1.28b	1.35b
Nicosulfron at 0.7 kg ai ha^{-1}	1.41b	1.22c	1.23c
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	1.39b	1.29b	1.44a
Hoe weeding at 3 & 6WAS	1.44a	1.24bc	1.29b
Weedy check	1.43ab	1.61a	1.36b
SE ± 0.06			

Means followed by the same letter(s) are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error 3. kg ai ha^{-1} = kilogram active ingredient per hectare
g ai ha^{-1} = gram active ingredient per hectare

4.13 Number of Days to 50 % Tasseling.

Number of days to 50 % tasseling as influenced by weed control treatments and variety during 2020 rainy season is shown on Table 4.15 Weed control treatments had significant effect on number of days to 50 % tasseling. At Samaru plots weeded twice at 3 and 6 WAS took more number of days to attain 50 % tasseling but statistically similar with plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus hoe weeded at 6 WAS, Atrazine at 2.0 kg ai ha^{-1} and weedy check, the fewest days to attain 50 % tasseling was observed at plots treated with Atrazine at 2.0 kg ai ha^{-1} plus hoe weeded at 6 WAS and Nicosulfuron at 0.7 kg ai ha^{-1}. At Mando, weedy check plots took more days to attain 50 % days to tasseling followed by the rest of the weed control measures except the hoe weeded plots at 3 and 6 WAS.

Table 4.13: Effect of Weed Control Treatments and Variety on Number of Days to 50 % Tasselling of Maize during the 2020 rainy season at Samaru Mando.

Treatment	Tasselling	
	Samaru	Mando
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	60.17ab	57.00ab
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	59.00b	57.00ab
Nicosulfron at 0.7 kg ai ha^{-1}	59.17b	57.08ab
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	59.83ab	56.50ab
Hoe weeding at 3 & 6WAS	60.92a	56.08b
Weedy check	59.50ab	59.00a
SE±	0.48	0.79
Variety (V)		
SAMMAZ 17	60.33a	55.42b
SAMMAZ 29	59.17ab	57.37a
SAMMAZ 54	59.17ab	58.54a
SE±	0.34	0.56
Interaction		
W × V	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant
WAS = Weeks After Sowing
SE = Standard Error

The varietal response to 50 % days to tasseling was significant at both locations. At Samaru SAMMAZ 17 took longer days to attain 50% tasseling but statistically similar to SAMMAZ 29 and SAMMAZ 54. However, at Mando, SAMMAZ 54 and SAMMAZ 29 took longer time to attain 50% tasseling which was at par with SAMMAZ 17.

There was no significant interaction between weed control treatments and variety on number of days to 50 % tasseling.

4.14 Number of Days to 50 % Silking

The effect of weed control on 50 % days to silking during 2020 rainy season at Samaru and Mando are presented in Table 4.14.

There was no significant effect of weed control treatments at both locations.

Varietal response was only significant at Mando where SAMMAZ 17 attained more number of days to 50 % silking, however it was followed by SAMMAZ 29. The lowest number of days was recorded in plots with SAMMAZ 54.

There was no significant interaction between weed control and variety on number of days to silking.

4.15 Number of Cobs Per Plot.

Table 4.15 shows the effect of weed control treatments and variety on number of cob per plot during the 2020 rainy season at Samaru and Mando. Weed control treatments had significant effect on number of cobs per plot.

At Samaru, plots treated with Nicosulfuron at 0.7 kg ai ha^{-1}significantly produced more number of cobs but were statistically similar with plots treated with Atrazine at 2.0 kg ai ha^{-1} plus hoe weeded at 6 WAS and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6WAS. Atrazine at 2.0 kg

ai ha^{-1}, hoe weeded at 3 and 6WAS and weedy check produced the least. At Mando all weed control treatments produced statistically similar and more number of cobs per plot with the exception of weedy check which recorded the lowest number.

The effect of variety on number of cobs per plot at both locations was not significant. The interaction between weed control treatments and variety at both location was not significant.

4.16 Cob Weight Per Plot.

The significant effect of weed control treatments and variety on cob weight per plot during 2020 rainy season at Samaru and Mando is presented in Table 4.16.

At Samaru, plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus hoe weeded at 6WAS and Nicosulfuron at 0.7 kg ai ha^{-1} significantly produced heavier cobs per plot but were statistically similar with plots weeded at 3 and 6WAS, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. It was however followed by Atrazine at 2.0 kg ai ha^{-1}. The weedy check recorded the lowest.

In Mando all weed control treatments with the exception of weedy check produced statistically similar and heavier cobs.

Effect of variety on cob weight per plot was significant at both locations. At Samaru, SAMMAZ 17 and SAMMAZ 29 produced heavier cobs than SAMMAZ 54 while at Mando, SAMMAZ 17 produced significantly heavier cobs than the other two varieties that had the least cob weight.

There was no significant interaction between weed control treatments and variety on cob weight per plot at both locations.

Table 4.14: Effect Weed Control Treatments and Variety on Number of Days to 50 % Silking of Maize during the 2020 rainy season at Samaru and Mando.

	Silking.	
	Samaru	Mando
Treatment		
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	61.33	63.16
Atrazine at 2.0 kg ai ha^{-1} +	60.67	63.50
hoe weeding at 6WAS		
Nicosulfron at 0.7 kg ai ha^{-1}	60.25	62.91
Nicosulfron at 0.7 kg ai ha^{-1} +	60.00	64.16
hoe weeding at 6WAS		
Hoe weeding at 3 & 6WAS	60.00	63.41
Weedy check	59.92	64.16
SE±	0.58	0.54
Variety (V)		
SAMMAZ 17	60.58	65.04a
SAMMAZ 29	60.45	63.54b
SAMMAZ 54	60.04	62.08c
SE±	0.41	0.38
Interaction		
W × V	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant
WAS = Weeks After Sowing
SE = Standard Error

Table 4.15: Effect of Weed Control Treatments and Variety on Number of Cob per plot of Maize during the 2020 rainy season at Samaru and Mando.

Treatment	Number of Cob.	
	Samaru	Mando
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	12.17b	13.25a
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	12.75ab	13.25a
Nicosulfron at 0.7 kg ai ha^{-1}	14.50a	13.25a
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	13.00ab	13.08a
Hoe weeding at 3 & 6WAS	12.33b	13.08a
Weedy check	12.08b	11.50b
SE±	0.62	0.32
Variety (V)		
SAMMAZ 17	12.42	12.63
SAMMAZ 29	13.38	12.92
SAMMAZ 54	12.63	13.17
SE±	0.44	0.22
Interaction		
W × V	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant
WAS = Weeks After Sowing
SE = Standard Error

Table 4.16: Effect of Weed Control Treatments and Variety on Cob Weight Per plot (kg) of Maize during the 2020 rainy season at Samaru and Mando.

Treatment	Cob Weight Per Plot(kg)	
	Samaru	Mando
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	2.77bc	2.69a
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	3.07ab	2.91a
Nicosulfron at 0.7 kg ai ha^{-1}	3.12a	2.81a
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	3.13a	2.89a
Hoe weeding at 3 & 6WAS	3.04ab	2.63a
Weedy check	2.61c	2.03b
SE±	0.11	012
Variety (V)		
SAMMAZ 17	3.08a	2.93a
SAMMAZ 29	2.95a	2.51b
SAMMAZ 54	2.83b	2.53b
SE±	0.08	0.08
Interaction		
W × V	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant
WAS = Weeks After Sowing
SE = Standard Error

4.17 Cob Diameter

The influence of weed control treatments and variety on cob diameter during rainy season of 2020 at Samaru and Mando is shown in Table 4.17. Significant differences exist among the weed control treatments on cob diameter at Samaru.

Plots that received Nicosulfuron at 0.7 kg ai ha^{-1} significantly recorded widest and biggest cobs which were statistically similar with the rest of the weed control treatment except the weedy check that produced the lowest cob diameter.

The effect of variety on cob diameter was only significant at Samaru, SAMMAZ 17 and SAMMAZ 29 significantly produced bigger cobs while the least was recorded in plot with SAMMAZ 54.

There is significant interaction between weed control measures and variety on cob diameter at Mando.

Table 4.17a. presents the interaction of factors on cob diameter at Mando.

SAMMAZ 54 in combination with Atrazine at 2.0 kg ai ha-1 plus supplementary hoe weeded at 6 WAS significantly produced bigger cobs but statistically similar when Atrazine at 2.0 kg ai ha-1 plus hoe weeded at 6 WAS was combined with SAMMAZ 29 and Nicosulfuron at 0.7 kg ai ha-1 plus supplementary hoe weeded at 6 WAS together with SAMMAZ 29. Cobs with least diameter was recorded in combination of Atrazine at 2.0 kg ai ha-1 plus supplementary hoe weeded at 6 WAS and SAMMAZ17.

Table 4.17: Effect of Weed Control Treatments and Variety on Cob Diameter (cm) of Maize during the 2020 rainy season Samaru and Mando.

Treatment	Cob Diameter.(cm)	
	Samaru	Mando
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	4.34ab	4.31
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	4.29ab	4.24
Nicosulfron at 0.7 kg ai ha^{-1}	4.42a	4.09
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	4.34ab	4.27
Hoe weeding at 3 & 6WAS	4.29ab	4.31
Weedy check	4.24b	4.09
SE±	0.05	0.09
Variety (V)		
SAMMAZ 17	4.41a	4.11
SAMMAZ 29	4.37a	4.27
SAMMAZ 54	4.18b	4.28
SE±	0.04	0.06
Interaction		
W × V	NS	*

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
* = Significant at 5%
WAS = Weeks After Sowing NS= Not Significant
SE = Standard Error

Table 4.17a: Interaction between weed control treatments and maize varieties on Cob Diameter at Mando during 2020 rainy season.

	Variety		
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	4.21c	4.36b	4.35b
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	3.85ef	4.41a	4.46a
Nicosulfron at 0.7 kg ai ha^{-1}	4.07de	4.04e	4.18c
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	4.23bc	4.41a	4.19c
Hoe weeding at 3 & 6WAS	4.20c	4.35b	4.38ab
Weedy check	4.09d	4.04e	4.15cd
SE ± 0.06			

Means followed by the same letter(s) are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error 3. kg ai ha^{-1} = kilogram active ingredient per hectare

4.18 Cob Length

Table 4.18 shows the effect of weed control and variety on cob length per plant during 2020 rainy season at Samaru and Mando. Weed control treatments had significant effect on cob length per plant only at Samaru. Plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus hoe weeded at 6 WAS produced significantly longer cobs that was statistically similar with all weed control treatments with the exception of weedy check and plots that received Nicosulfuron at 0.7 kg ai ha^{-1}.

At Mando there was no significant difference across all weed control measures. The effect of variety on cob length per plant was significant at both locations. At Samaru, SAMMAZ 29 significantly produced longer cob but similar to SAMMAZ 17. The lowest was recoded in plots with SAMMAZ 54.

In Mando SAMMAZ 17 recorded longest cob but similar with SAMMAZ 29, the least was recorded from SAMMAZ 54.

There was no significant interaction between weed control and variety on cob length at both locations.

Table 4.18: Effect of Weed Control Treatments and Variety on Cob Length Per Plant of Maize during the 2020 rainy season at Samaru and Mando.

Treatment	Cob Length.(cm)	
	Samaru	Mando
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	17.25ab	14.92
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	18.81ab	15.05
Nicosulfron at 0.7 kg ai ha^{-1}	17.57b	14.52
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	20.59a	14.71
Hoe weeding at 3 & 6WAS	17.80ab	15.10
Weedy check	15.61b	14.44
SE±	3.63	0.37
Variety (V)		
SAMMAZ 17	17.72ab	15.38a
SAMMAZ 29	19.65a	14.69ab
SAMMAZ 54	16.16b	14.29b
SE±	0.89	0.26
Interaction		
W × V	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant
WAS = Weeks After Sowing
SE = Standard Error

4.19 Number of Row Per Cob.

The influence of weed control treatments and variety on number of rows per cob during 2020 rainy season at Samaru and Mando is presented in Table 4.19.

There was no significant effect of weed control treatment at all sampling period at both locations. The effect of variety on number of rows per cob was also not significant at all the sampling period at both locations. There was no significant interaction between weed control treatments and variety at both locations.

4.20 100- Grain Weight

Response of 100 grain weight to weed control and variety during 2020 rainy season at Samaru and Mando is shown in Table 4.20

There was no significant effect of weed control treatment and variety on 100 grain weight at both locations. There was significant interaction between the factors at Mando as presented on Table 4.20a. Hoe weeding at 3 and 6 WAS together with SAMMAZ 29 and SAMMAZ 54 produced significantly higher 100 seed weight while the least was recorded when SAMMAZ 54 was combined with Nicosulfuron at 0.7 kg ai ha^{-1}.

Table 4.19: Effect of Weed Control Treatments and Variety on Number of rows per cob of Maize during the 2020 rainy season at Samaru and Mando.

Treatment	Number of Row Per Cob.	
	Samaru	Mando
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	13.82	14.10
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	14.32	13.87
Nicosulfron at 0.7 kg ai ha^{-1}	14.17	14.47
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	14.13	13.62
Hoe weeding at 3 & 6WAS	14.02	13.70
Weedy check	13.98	13.83
SE±	0.29	0.33
Variety (V)		
SAMMAZ 17	14.27	13.80
SAMMAZ 29	14.15	13.84
SAMMAZ 54	13.80	14.15
SE±	0.21	0.23
Interaction W × V	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant
WAS = Weeks After Sowing
SE = Standard Error

Table 20: Effect of Weed Control Treatments and Variety on 100 Seed Weight of Maize during the 2020 rainy season at Samaru and Mando.

Treatment	100 Seed Weight.(g)	
	Samaru	Mando
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	26.53	24.55
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	26.17	25.21
Nicosulfron at 0.7 kg ai ha^{-1}	24.82	24.74
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	24.97	24.93
Hoe weeding at 3 & 6WAS	26.24	23.84
Weedy check	26.58	23.89
SE±	0.81	0.73
Variety (V)		
SAMMAZ 17	25.60	24.11
SAMMAZ 29	26.43	24.83
SAMMAZ 54	25.62	24.63
SE±	0.57	0.5
Interaction		
W × V	*	NS

.Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
* = Significant at 5%
WAS = Weeks After Sowing NS=Not Significant
SE = Standard Error

Table 4.20a: Interaction between weed control treatments and maize varieties on 100 seeds weight at Samaru during 2020 rainy season

		Variety	
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	26.20a	27.40a	25.97a
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	27.75a	25.48a	25.28b
Nicosulfron at 0.7 kg ai ha^{-1}	25.03b	26.95a	22.48b
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	23.43b	25.43ab	26.05a
Hoe weeding at 3 & 6WAS	24.48b	24.88a	29.38a
Weedy check	26.73	28.48a	24.55b
SE ±	4.02		

.Means followed by the same letter(s)are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error 3. kg ai ha^{-1} = kilogram active ingredient per hectare

4.21 Grain yield in Tonnes Per Hectare.

Table 4.21 shows the effect of weed control treatments and variety on grain yield in tonne per hectare during 2020 rainy season at Samaru and Mando.

Grain yield significantly responded to both factors at both locations. At Samaru plots that received Nicosulfuron at 0.7 kg ai ha^{-1} and Nicosulfuron at 0.7 kg ai ha^{-1} plus hoe weeded at 6 WAS produced higher grain yield which was statistically similar to plots that received Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus hoe weeding at 6WAS and hoe weeded at 3 and 6 WAS. The lowest was recorded in weedy check plots.

At Mando, all the weed control treatments with the exception of weedy check produced statistically similar grain yield.

The effect of variety on grain yield in tonnes ha^{-1} was significant at both locations. At Samaru, SAMMAZ 17 significantly produced highest grain yield that was statistically similar with SAMMAZ 29 and SAMMAZ 54. However, at Mando SAMMAZ 17 produced highest grain yield. The least was produced by SAMMAZ 29 and SAMMAZ 54. There was significant interaction between weed control treatments and variety on grain yield in tonnes ha^{-1} at Mando and is presented in Table 4.21a.

SAMMAZ 17 when combined with all weed control measures produced significantly higher grain yield which was at par with other interactions. The least was recorded when SAMMAZ 54 was combined with weedy check.

4.22 Threshing percentage.

Table 4.22 present the effect of weed control and variety on threshing percentage during 2020 rainy season at Samaru and Mando.

The effect of weed control was significant at Mando, in which, all weed control methods with the exception of weedy check significantly produced higher threshing percentage.

The effect of variety was not significant at both locations and also the interaction of factors.

4.23 Harvest Index

Table 4.23 present the effect of weed control and variety on harvest index during 2020 rainy season at Samaru and Mando. Weed control treatments had significant effect on harvest index. At Samaru plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} and weedy check significantly recorded highest harvest index but statistically similar with rest of weed control treatments with the exception of plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The effect of variety was not significant at both locations and the interaction between the factors was not significant.

Table 4.22: Effect of Weed Control Treatments and Variety on Threshing percentage of Maize during the 2020 rainy season at Samaru and Mando.

Treatment	Threshing Percentage(%)	
	Samaru	Mando
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	42.35	32.10ab
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	35.96	36.88a
Nicosulfron at 0.7 kg ai ha^{-1}	39.21	40.47a
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	41.82	42.85a
Hoe weeding at 3 & 6WAS	34.28	41.94a
Weedy check	36.46	25.85b
SE±	3.12	3.06
Variety (V)		
SAMMAZ 17	39.78	39.41
SAMMAZ 29	39.24	35.82
SAMMAZ 54	36.01	35.36
SE±	2.26	2.17
Interaction W × V	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant
WAS = Weeks After Sowing
SE = Standard Error

Table 4.23: Effect of Weed Control Treatments and Variety on Harvest Index of Maize during the 2020 rainy season at Samaru and Mando.

Treatment	Harvest Index.	
	Samaru	Mando
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	59.28ab	44.48
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	58.86ab	44.24
Nicosulfron at 0.7 kg ai ha^{-1}	58.26a	34.94
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	51.21b	39.36
Hoe weeding at 3 & 6WAS	59.96ab	34.28
Weedy check	70.62a	40.31
SE±	3.17	1.50
Variety (V)		
SAMMAZ 17	63.20	39.24
SAMMAZ 29	55.38	39.61
SAMMAZ 54	61.62	39.99
SE±	2.24	0.75
Interaction		
W × V	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS =Not Significant
WAS = Weeks After Sowing
SE = Standard Erro

Table 4.21: Effect of Weed Control Treatments and Variety on Grain Yield in t ha^{-1} of Maize during the 2020 rainy season at Samaru and Mando.

	Grain Yeild in t ha^{-1}.	
	Samaru	Mando
Treatment		
Weed control (W)		
Atrazine at 2.0 kg ai ha^{-1}	5.19ab	4.9a
Atrazine at 2.0 kg ai ha^{-1} +	4.77ab	5.1a
hoe weeding at 6WAS		
Nicosulfron at 0.7 kg ai ha^{-1}	5.41a	4.9a
Nicosulfron at 0.7 kg ai ha^{-1} +	5.63a	5.1a
hoe weeding at 6WAS		
Hoe weeding at 3 & 6WAS	4.61ab	4.8a
Weedy check	4.09b	3.2b
SE±	0.36	0.29
Variety (V)		
SAMMAZ 17	5.36a	5.97a
SAMMAZ 29	5.07ab	4.10b
SAMMAZ 54	5.07ab	3.92b
SE±	0.26	0.21
Interaction		
W × V	NS	*

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
* = Significant at 5%
WAS = Weeks After Sowing NS= Not Significant
SE = Standard Error

Table 4.21a: Interaction between weed control treatments and maize varieties on Grain Yeild In t ha^{-1} at Mando during 2020 rainy season

		Variety	
Weed Control	SAMMAZ 17	SAMMAZ 29	SAMMAZ 54
Atrazine at 2.0 kg ai ha^{-1}	6.5a	3.8b	4.3b
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	6.2a	4.7ab	4.2b
Nicosulfron at 0.7 kg ai ha^{-1}	5.5a	4.7ab	4.5b
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	5.5a	4.3b	4.5b
Hoe weeding at 3 & 6WAS	6.2a	4.1b	4.1b
Weedy check	5.79a	1.8c	1.9c
SE ±	0.06		

Means followed by the same letter(s) are not significantly different at 5% probability level according to Duncan's multiple range test (DMRT)
SE = Standard Error 3. kg ai ha^{-1} = kilogram active ingredient per hectare
g ai ha^{-1} = gram active ingredient per hectare

4.24 Correlation Analysis

The matrix of correlation among growth, yield components and grain yield of maize during the 2020 rainy season at Samaru and Mando are shown in Table 4.24a and 4.24b respectively. At Samaru, there was a significant correlation between grain yield and shoot dry weight similar correlation occurs between grain yield and cob diameter. However, the relationship between grain yield and weed dry weight, weed cover score were negative.

At Mando significant correlation exist between grain yield with 100 seed weight and plant height also positive correlation occurs with all other parameters with the exception of weed dry weight and weed cover score that recorded negative correlation with the yield.

Table 4.24a. Matrix of correlation coefficient between growth and yield parameters of maize during 2020 rainy season at samaru.

	1	2	3	4	5	6	7	8	9	10
1	1.00									
2	0.251	1.00								
3	0.354*	-0.082	1.00							
4	0.382**	-0.079	0.353*	1.00						
5	0.265	0.122	-0.016	-0.082	1.00					
6	0.279	-0.063	0.274	0.497	-0.144	1.00				
7	0.188	0.194	0.178	0.168	-0.030	0.385	1.00			
8	-0.011	0.159	-0.196	0.409**	0.069	-0.492**	0.021	1.00		
9	-0.173	0.142	-0.331	0.367*	0.147	-0.443**	-0.107	0.557**	1.00	
10	0.263	0.049	0.102	0.038	0.023	0.031	0.134	0.037	-0.053	1.00

DF = (N-2) = 70
* Significant at 5% level probability
**Significant at 1% level probability
1.Grain yield
2.Shoot dry weight
3.Cob diameter
4.Leaf area index
5.100: grain weight
6.Plant height
7.Number of leaves
8.Weed dry weight
9.Weed cover score
10.Crop vigour score

Table 4.24b. Matrix of correlation coefficient between growth and yield parameters of maize during 2020 rainy season at mando

	1	2	3	4	5	6	7	8	9	10
1	1.00									
2	0.006	1.00								
3	0.252	-0.278	1.00							
4	0.316*	0.029	0.144	1.00						
5	0.236	0.044	0.138	-0.005	1.00					
6	0.558**	-0.214	0.085	0.493	0.074	1.00				
7	0.251	-0.075	0.141	0.267	0.212	0.334*	1.00			
8	-0.203	0.089	-0.158	-0.404	-0.139	-0.626**	-0.286	1.00		
9	-0.204	0.161	-0.382**	-0.251	-0.026	-0.310*	0.090	0.018	1.00	
10	0.065	-0.148	-0.227	0.066	0.027	-0.014	0.134	0.731**	0.199	1.00

DF = (N-2) = 70
* Significant at 5% level probability
**Significant at 1% level probability
1.Grain yield
2.shoot dry matter
3.Cob diameter
4.100: grain weight
5.Leaf area index
6.Plant height
7.Number of leaves
8.Weed dry weight
9.Weed cover score
10.Crop vigour score

CHAPTER FIVE

5.0 DISCUSSION

Generally, the three maize varieties performed optimally in terms of growth and yield component at both locations. The positive responses obtained could be attributed to the soil physical and chemical attributes which includes the textural class of the soil, higher organic matter contents, total nitrogen, available phosphorus as well as potassium at both locations. The maize crop must have had asses to available nitrogen during the early growth stages thereby leading to better plant growth. The favorable weather conditions could also be responsible for the positive performance of maize at both locations. This agrees with the findings of Carrie *et. al*, (2019) who said maize growth and yield parameters are highly influenced by environmental factors such as temperature, relative humidity and soil moisture content.

5.1 Effect of Weed Control Treatments on Weeds

All weed control treatments significantly reduced weed cover score, total weed density and weed dry weight at both locations compared to weedy check. However, application of Nicosulfuron at 0.7 kg ai ha^{-1} with supplementary hoe weeding at 6 weeks after sowing led to reduction in weed dry weight, weed cover score and weed density at both Samaru and Mando. This could be due to the efficacy of the herbicide which destroyed most of the weed seed bank as well as the emerged weeds. This is in line with the findings of (Das, 2008) who attributed reduced weed density, weed cover score and weed dry weight in maize to the effectiveness of Nicosulfuron herbicides.). The lowest weed density was recorded in plots treated with hand weeding and hoeing followed by Nicosulfuron whereas the maximum was recorded in weedy check. Like density, dry weight of weeds the minimum was observed in hand weeding and hoeing followed by Nicosulfuron (Tesfay *et al.,* 2014). According to Fariba *et al.*

(2013) Nicosolfuron+Weeding decreased weed Field bind weed dry weight as compared to Weedy check treatment by 77.78 % and decreased weed Field bindweed density as compared Weedy check treatment by 91.66%.

5.2 Effect of Weed Control Treatments on the Growth and Yield of Maize

The result of this study shows that the growth and yield parameters of maize was significantly enhanced when weeds were controlled at both locations. However, application of Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeding at 6 WAS resulted in better performance of the crop in terms of growth parameters such as crop vigour score, plant height, leaf area index, shoot dry weight, crop growth rate and relative growth rate when compared to weedy check plots which could be due to the effectiveness of the herbicide to control the weeds there by making the growth factors such as nutrient, sunlight and space available to the crop, whereas weedy check had least performance of the above growth parameters. This could be associated with the aggressive nature of the weed in competing for scare growth resources which led to poor performance. This is in line with Lum *et. al,* (2005) who reported that Nicosulfuron increased maize yield at Alabata by 96 % in 2000, 100 % in 2001 and 34 to 54 % in 2002 and in Ilorin by 79 to 83 % in 2001 and 60 to 69 % 2002 when compared with non-weeded control.

The positive role of weed control treatment (Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeding at 6 WAS) observed above could have been a reason for positive responses of most of the yield components such as grain yield and cob weight per plot. This could be due to the ability of the weed control measure applied to control weeds beyond the level that can have significant effect to the crop. According to Armindo *et al*. (2019) spraying of Nicosulfuron herbicide to suppress the forages growth in intercropping with maize resulted in significant increase in grain weight per ear (GWE) and maize grain yield (MGY).

This result is in line with the findings of Pamplona *et al* (1990) who reported that increase in yield component and grain yield of maize because the crop was free from weeds during its critical period of weed interference.

5.3 Varietal Responses

All the varieties used during this study responded positively to treatments but SAMMAZ 17 outperformed others varieties on growth parameters such as plant height, leaf area index, shoot dry weight, relative growth rate, crop growth rate and yield parameters (grain yield and cob weight per plot). This could be due to inherent genetic makeup that differs them and also SAMMAZ 17 is an medium maturing variety have more time on the field to photosynthesis and produced much assimilate that will be translated in to the final yield. These findings conform to the result obtained by Mani *et al* (2002) who observed a significant increase in plant height and grain yield among varieties. Namakka (2002) reported non-significant differences in some growth, yield component and yield of two varieties.

Also, Sani *et al* (2011) reported that all maize varieties exhibited close similarity in performance which was above average. None of the varieties yielded less than 50% of the potential yield of hybrid maize in the ecological area of evaluation. Farmers are thus advised to ensure strict compliance with recommended production practices in order to attain higher maize grain yields.

All varieties responded positively to weed control treatment, However SAMMAZ 17 recorded significant impact this could be due morphological features this finding is in line with Nadeem *et al.* (2006) concluded that the grain yield of maize crop was increased with the use of herbicides as the herbicide application quickly suppresses the weeds germination and ultimately provides a competition free environment for the crop plant to get all the available resources alone.

5.4 Interactions

The significant interaction between weed control treatments and varieties was observed to have influence on weed cover score, weed dry weight, crop vigour score, leaf area index, shoot dry weight, crop growth rate, relative growth rate, cob diameter, 100-grain weight and grian yield in tonne per hectare.

The result shows that weedy check combine with SAMMAZ 17 resulted in higher weed cover score and weed dry weight. Application of atrazine at 2.0 kg produced higher leaf area index at Samaru and Mando respectively which could be due to the efficiency of the herbicide and total removal of the weeds ai ha^{-1} to SAMMAZ 29 and SAMMAZ 17 produced vigourous crops, application of atrazine at 2.0 kg ai ha^{-1} with SAMMAZ 29 and hoe weeding at 3 and 6 WAS in a hoe weeded plots. Heavier shoot dry matter was produced with the application of Nicosulfuron at 0.7 kg ai ha^{-1} with hoe weeding at 6 WAS combine with SAMMAZ 17. This could be due to the combination of chemical and hoe weeding method, SAMMAZ 29 with weedy check produced higher relative growth rate and crop growth rate this could be due the varietal inherent genetic makeup that gave the crop ability grow faster than the weeds.

Plots treated with atrazine at 2.0 kg ai ha^{-1} with hoe weeding at 6 WAS significantly had wider cob diameter and heavier 100 –seed weight, at the final yield result shows that SAMMAZ 17 with all weed control methods significantly produced higher yield and this could be due to the fact that, the variety was bred to be medium maturing variety have enough time to photosynthesis. The above result is in line with Khan *et al.* (2016) who found that the interaction effect on grain yield in maize showed that the combination of maize hybrid P3025 x Dual gold 960EC gave the maximum biological yield of 11.013-ton ha^{-1}, while the minimum biological yield (4.825-ton ha^{-1}) was recorded for maize hybrid P-32T78 x weedy check. Nyasha *et al.*, (2018) also discovered that there was a significant interaction

($p<0.05$) between herbicide combination and maize inbred line on grain yield. While according to Khan *et al.* (2016) result showed significant effects of different herbicides, maize hybrids and their interactions on plant height in maize. Also, Ahmad, (2012) revealed that different maize hybrids showed significant variations for plant height. Subhan *et al.* (2007) reported highest maize plant height, when the crop was treated with Dual gold, Primextra gold and atrazine as pre-emergence.

5.5 Correlation Analysis

A positive and highly significant relationship between grain yield, growth and yield parameters on plant height, shoot dry weight, Leaf Area Index (LAI), Cob diameter are important indices of grain yield and plays significant role in enhancing light interception which enhance the production and translocation of assimilation that resulted in shoot dry matter and 100-seed weight which was later turn to yield this agrees with the findings of Justin (2016) who reported that grain yield was highly and positively correlated with number of grain per ear, grain weight and not significantly correlated with number of ear per plant. The negative association between weed cover score and weed dry weight on grain yield of maize shows weed infestation as a result of competition of growth resources which eventually reduce yield. This confirms the observation of Gana (2015) who reported negative correlation between grain yield and weed cover score in maize. Similar results were obtained in maize by Mahadi (2011).

CHAPTER SIX

6.0 SUMMARY AND CONCLUSION

6.1 Summary

Field trials were conducted during the rainy season of 2020 at the research farms of the Institute for Agricultural Research, Ahmadu Bello University, Zaria; Situated at Samaru (11^0 11 N; 07^0 38 E 686m above sea level) and the College of Animal Health Farms Situated at Mando Kaduna (11^0 39 N, 08^0 02 E, 620m above sea level) all in Northern Guinea Savanna of Nigeria. The research was aimed at determining the effect of weed control treatments on Maize using Atrazine and Nicosulfuron and evaluation of performance of different maize varieties.

The treatments were laid out in randomized complete block design (RCBD) in a split plot arrangement and replicated four times. The weed control treatments were assigned to the main plots while the varieties occupied the subplots. The gross and net plot were $12m^2$ and $2.25m^2$ respectively. The results showed that weed dry weight, weed density and weed cover score were significantly decreased by weed control treatments compared to weedy check plots. The treatments with Nicosulfuron at 0.7 kg ai ha^{-1} had significantly higher values for crop vigour score, plant height, number of leaves, leaf area index and shoot dry weight at both locations. Yield parameters such as cob weight $plot^{-1}$, Cob diameter, Cob length and grain yield in tonne ha^{-1} significantly increased in plots treated with Nicosulfuron at 0.7 kg ai ha^{-1}.

SAMMAZ 17 outperformed other two varieties (SAMMAZ 29 and SAMMAZ 54) significantly both locations for growth and yield parameters. Significant interaction between weed control treatments and variety was observed at weed cover score, leaf area index, weed dry weight, crop vigour score, shoot dry weight, crop growth rate, relative growth rate, cob diameter, 100- seed weight and grain yield in

tonne ha^{-1}. Where the combination of SAMMAZ 17 with all weed control treatments significantly recorded highest grain yield in tonne ha^{-1}.

There was significant and positive correlation between grain yield and the parameters like shoot dry weight, Cob diameter, leaf area index, 100-seed weight, plant height, number of leaves at both locations. However, negative correlation was observed between weed parameters such as weed cover score and weed dry weight with yield and yield parameters of maize varieties.

6.2 Conclusion

Based on the results obtained from these trails. It can be concluded that Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeding at 6 WAS and SAMMAZ 17 should be adapted by maize farmers in Northern Guinea Savanna of Nigeria since they resulted in better weed control, growth and yield of maize.

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Appendix 1: Mean of temperature (^{o}C), relative humidity (%), sunshine hours and rain fall in 2020 season at Samaru.

Months	Samaru					
	Air temp (oC)		Relative Humidity (%)		Sunshine	Rain fall
	Max	Min	10 a.m	4 p.m	Hours.day-1	(mm)
May	37.35	24.19	52.51	29.9	7.38	12.87
June	32.63	22.13	72.2	56.17	7.36	9.48
Jully	30.63	20.07	79	68.27	5.3	20.08
August	29.67	19.5	81.9	72.37	4.58	16.67
September	31.62	25.45	77.28	65.1	6.31	22.94
October	33.13	18.22	58.45	52.9	8.16	11.2
November	33.83	12.8	20.83	23.03	9.3	0

Source: Metrological unit of Institute for Agricultural Research, (IAR) Samaru.

Appendix 2: Mean of temperature (^{o}C), relative humidity (%), sunshine hours and rain fall in 2020 season at Mando.

Months	Mando					
	Air temp (oC)		Relative Humidity (%)		Sunshine	Rain fall
	Max	Min	10 a.m	4 p.m	Hours.day-1	(mm)
May	29.7	24.2	54.8	35.1	7.5	13.4
June	33.4	25.6	55.2	39.8	6.8	10.6
Jully	32.1	23.5	57.4	51.3	5.3	25.6
August	31.2	22.6	61.7	54.5	4.3	29.1
September	30.6	21.2	54	48.9	6.1	23.42
October	33.3	20.4	51	47	7.9	14.11
November	NA	NA	25	22.8	8.1	0

NA: Not Available

Source: Kaduna state, Agricultural Development Project (KADP)