بسم الله الرحمن الرحيم

Sudan University of Sciences and Technology

College of Agricultural Studies

Department of Plant Protection

A thesis submitted in partial fulfillment of the requirements for the degree in plant Protection**.** of B.Sc. Agric.

Effect of Weed Interference on Growth of Maize (*Zea mays* L.) in Shambat, Bahri Locality, Khartoum State, Sudan

By:

Yahya Ahmed Abaker Yousif

Supervisor:

Professor, Dr.: Mukhtar Abdel Aziz Mohamed Osman

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Dedication

To whom are the reasons of my life to those who have made everything

for me in order to achieve this level of education

My dad and mom

To my brothers and sisters and their children

Acknowledgments

All my thanks and prays to “Allah”, who gave me strength and patience to complete this research.

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Abstract

The experiment was conducted in College of Agricultural Studies, Shambat, Sudan University of Science & Technology, Khartoum State during the summer season of 2017 to determine the effect of weed interference on maize growth parameters.

Results of this investigation showed that maize growth parameters which includes plant height (cm), number of leaves/plant, shoot fresh weight (g)/plant and shoot dry weight (g)/plant reduced when the duration of weed infested period increased and increased when the duration of weed infested period decreased. From the results of these studies it can be concluded that, keeping the crop long weed-free duration is enough to provide high growth parameters.

Although maize growth parameters was increased in all weed free durations, these increases were positively related with prolonged weed free durations. The highest growth parameters was provided from treatments in which weeds were left for the shortest periods from emergence.

المستخاص:

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CHAPTER 1

INTRODUCTION

Cereal grains are the most important component of Sudanese diet. An understanding of cereal's production characteristics, in the Sudan, is vital for maintenance of efficient and sustainable agricultural and food production (Abdel Rahman, 2002).

Maize *(Zea mays* L.*),*also known as Indian corn, or simply corn, is considered as the third most important cereal crop in the world, after wheat and rice, but more important than either as a forage crop. It is used as human food, animal feed as well as raw material for some industries (Ali, 2003). The recent changes in the environment, including global warming, decreased rains and their distribution. The gap between consumption and food commodities production lead to outbreaks of famines in various countries.

The vast arable land, reasonable supply of irrigation water and variable climatic conditions, which ensure production of a wide range of crops, makes Sudan the proper candidate for solving

food and feed problems on the international level. However, factors limiting crop regional production in Sudan are many, among them weed competition is the most important (Mahgoub, 2002).

Maize is not only a major cereal in the present- day world but it was also one of the basic food crops in America before the arrival of Christopher Columbus at the end of the fifteenth century (Mukhtar, 2006). The origin of it remains uncertain, although it is generally agreed that its evolution into modern forms took place primarily in Central America. The world production of maize in 1981 amounted to 452 million tonnes, which was greater than rice (412 million tonnes) and nearly as much as wheat million tonnes) (Mukhtar, 2006).

Maize is resently adopted in Sudan and may have been introduced during the Turkish colonial period in the nineteenth century. The popular name of it in Sudan Aish el Reef is consistent with the above notion. In the Sudan, maize is normally grown as a rain-fed crop in Kordofan, Darfur and

Southern states or in small irrigated areas in Northern states (Bashir, 2001).

Maize is a warm-season, annual crop and does best on fertile well drained, loamy soils. It can be grown successfully in soils with pH ranges from 5.5 rather acidic to 8.0 moderately basic. Maize requires large amounts of essential minerals, such as inorganic nitrogenous fertilizer, giving grain increase of about 30 kg for each kilogram of nitrogen applied up to 118 kg /ha. Thus, soil fertility must be high to obtain high yields. It can be grown in most of the world, it is best suited to regions where the average temperature, for three or four consecutive months, is between 21-32. Planting is generally delayed until the soil temperature is 13°C. or higher. The optimum temperature for plant growth during flowering and grain ripening is about 30°C. Little growth occurs if the temperature is below 18°C, and prolonged exposure to temperatures below 7°C may be lethal. In Northern Sudan first of November is a suitable sowing date for the crop (Mukhtar, 2006).

World- wide hundreds of millions of hectares are planted with maize every year and in Africa about 10-12 million hectares are planted with maize annually. Maize is more sensitive to water stress at flowering than at other times in the crop's life cycle (Mukhtar, 2006).

The leading exporting country is the United States, followed by Argentina, South Africa, Thailand, and France (Mukhtar, 2006).

Besides insect pests and diseases, weeds constitute a serious obstacle in maize production. They are plants growing out of place, unwanted and undesirable. They interfere with the utilization of land and water resources and thus adversely affect human welfare (Lavabre, 1991).

Weeds are the major constraint to crop production in all cultivated areas in Sudan. Unrestricted weed growth promotes soil degradation in cultivated lands and reduces yield of the main crops by 50-100 % (Hamada, 2000).

A survey made in the USA showed that losses resulting from weeds equalled those caused by insects and diseases combined.

On average weeds account for 45% losses, insects for 30%, diseases for 20% and other pests for 5% (Rao,1983). It was also found that reduction in crop yield due to weeds is highest in the tropics compared to temperate regions (Rao, 1983).

In Sudan maize received little attention and the available information is inadequate especially in area of weed competition. Thus, this study was conducted to assess the magnitude of growth parameters losses in maize due to weed infestation such as plant height (cm), number of leaves/plant, shoot fresh weight (g)/plant and shoot dry weigh (g)t/plant.

CHAPTER 2

LITERATURE REVIEW

In Sudan there is strong desire that in years to come maize production will be a real revolution in agriculture. Therefore, any research work on maize production will be of a paramount importance. However, its production is faced by a number of obstacles including pests and diseases. Among the serious pests limiting maize production are weeds. The implementation of diversification and intensification in irrigated agriculture resulted in serious weed problems. Information on weed competition in maize in Sudan is lacking and little work has been done in this area. Since, like other cereals crops, maize has a slow and a weak growth habit during the early stages of growth, therefore, it can not compete successfully with weeds (Mukhtar, 2006).

2.1 Even though a saturating population (heavy) of weeds throughout the season might reduce yield as much as 50 – 100%, these weeds can usually grow with the crop for a

certain period before they damage the crop (Mukhtar, 2006).

2.2 Weeds: Definition, Classification and Economic Importance:

A weed is a plant growing out of place, that is, a plant growing where it is not wanted, a plant interfering with the intended use of land, and a plant with negative value. It interferes with crop production, directly, through competition, parasitism and allelopathy (toxin production) or indirectly through hindering cultural and harvest practices (Rao, 1983; Lavabre, 1991; and Ibrahim, 2005).

Some common methods used to classify weeds are based on i) botanical (taxonomic) characteristics, ii) life history, iii) habitat, iv) physiology , v) degree of undesirability and evolutionary strategy.

By botanical characteristics (taxonomic) weeds are classified into kingdom, divisions (phyla), classes, orders, families, genera and species. They also are classified as dicotyledons (broadleaves) and monocotyledons (grasses). According to life

history plants are classified into annuals, biennials and perennials. On basis of habitat plants are classified as terrestrial (that is, they are found on land) and aquatic. On physiological basis plants are classified according to photosynthetic pathway into C_3 plants and C_4 plants. According to day length plants are classified into short-day, long-day and day-neutral. According to undesirability they can be classified into noxious and poisonous plants. By evolutionary strategy they can be classified into stress-tolerators, competitors and ruderals (Mukhtar, 2006).

Furthermore, aquatic weeds reduce the efficiency of irrigation canals by hindering water flow and encouraging siltation. Moreover, weeds

interfere with crop production in various ways.

i) Weeds reduce yields by competing with the crop directly for the resources of the environment and inputs in terms of water, nutrients, light, space and / or carbon dioxide.

ii) Reduce yields by releasing toxic substances or exudates which inhibit crop growth.

iii) Act as a reservoir for crop pests and diseases.

iv) Delay maturity and slowdown the process of harvesting.

v) Depress crop quality by contamination of the harvested product.

vi) Increase tendency for some crops to lodge or to go over , flat.

vii) Decrease the value of land specially perennials and parasitic ones.

viii) Waste excessive proportion of farmers time & ix) some weeds are reported to be poisonous to man and animals (Lavabre, 1991 and Hamada, 2000).

Increase in weed population has a direct effect on reduction in crop yield. The duration of weed infestation and the time of weed elimination have a great influence on crop growth and yield (Rao, 1983).

In many crops, weed infestation during the first 3 to 8 weeks is very critical (Rao, 1983). Unrestricted weed growth in cultivated lands reduces yield of the main crops by 50-100% in Sudan (Hamada, 2000).

Average crop losses due to weeds are estimated at 25% but may be as high as 50% or even 80% with certain food crops (Lavabre, 1991). A considerable loss in growth and yield of many food and fodder crops is caused by root-parasitic flowering plants. Root-parasitic weeds cause their damage on the host while they are still below the ground. Several Orobanche species have been described as economically significant pests in South and East Europe, West Asia and North Africa. It causes yield losses ranging from 5-100% (Mukhtar, 2006).

Witch weeds (Striga spp.) are considered to be the most important factor in yield losses in cereals such as sorghum, millet and maize. In countries like Ethiopia and the Sudan losses of 65-100% are common in heavily infested fields (Mukhtar, 2006).

Striga hermonthica is the most important parasitic weeds on cereals.

Losses in grain yield of sorghum (*Sorghum bicolor*) and millet (*Pennisetum glaucum (*L.)R.Br.) due to *Striga hermonthica*

damage are more than 70% in heavily infested fields (Hamada, 2000).

Weeds are not always harmful. Some weeds induce suicidal germination of *Striga hermonthica*. Weeds can also help in recycling soil nutrients. In addition, weeds are used as human food. Moreover, some weeds are important in traditional medicine such as *Cassia senna* (Hamada, 2000).

2.3 Effect of Weeds on Maize:

Maize is a plant which is extremely sensitive to competition from weeds because it emerges more slowly than weeds. Furthermore, the light level of fertilizer used rapidly creates competition between weeds and maize (Lavabre, 1991). Annual weeds commonly have a shorter life cycle than the crop with which they are competing. Since most weedy grasses are of the C_4 type, the greater effect from broad leaf species is likely explained by their more spreading growth form and more horizontal leaves that make them relatively more competitive for light. The lesser competitiveness of grasses must not be confused with their relative seriousness as weeds or difficulty to

control. Of the world's 10 most serious weeds, 8 are grasses or are grass like (Mukhtar, 2006). Yield is a complex character, highly influenced by the environment, and depends on several characters. It is the product of the multiplicative interactions among its components as well as their interactions with the environment. Therefore, determination of the degree of association between these characters is an essential step and useful in planning and evaluating crop production programs.

World, Losses in maize yield due to weed damage amounts to 40% (Mukhtar, 2006). The amount of damage to the crop depends on the duration and density of the weed infestation and on the relative time of emergence of the weed and maize (Mukhtar, 2006).

Maximum competition occurs when weeds and maize emerge concurrently, weeds that emerge early in the life of the crop are more than those emerging late. Late emerging weeds seedlings have to struggle for survival in competition with the rapidly growing crop (Mukhtar, 2006). .Weeds cause 35% - 40% yield losses in maize in the case of no control.

shed. Any wheels, draught animals or people's feet moving from infested fields should be cleaned. Waste land around field's boundaries should be kept clean of noxious weeds (Lavabre, 1991).

CHAPTER 3

MATERIALS AND METHODS

3.1 The Experimental Site:

This research includes two sets of experiments, the first set is weed free for X weeks, the second set is weedy for X weeks. The experiments were conducted in summer season of 2017 at Shambat, Bahri Locality, Khartoum State-Sudan-located within latitudes 15° and 40° N, and longitude 32° and 23° E Babiker *et al*. 2015).

3.2 Land Preparation, Sowing and the Layout of the Experiments:

In all experiments, in weed free treatments, weeds were removed frequently by repeated hand weeding to keep the crop free from weeds up to the end of the experiment. However, in treatments weedy for full season (control), weeds were left to grow, unrestrictedly, with the crop until the end of the experiment. Irrigation water was applied at 10-15 days interval according to temperature and other environmental conditions.

Cultural practices were carried out according to the Agricultural Research Corporation (ARC) recommendations.

3.2 The Weed Competition:

This research comprised 12 treatments arranged in a randomized complete block design, with three replications. Seeds of maize, Balady variety was sown on 19 January in Plots ni summer season, 8 seeds per pot, pot size was . Later the seedlings were thinned to 5 seedlings in each pot. The treatments involved weed free plots for 2,4,6,8,10 weeks after sowing, weedy plots for 2,4,6,8,10 weeks after sowing, weed free until the end of the experiment by repeated hand weeding and weedy until the end of the experiment.

In these competition experiments nitrogen at 2 N (80 lb of nitrogen/fed) in the form of urea was applied (½ dose at thinning stage and ½ dose when the plants were knee high).

Full season weed free and full season weedy treatments were included for comparison.

3.3 Data Collection:

3. 3.1 The crop:

3. 3.1. 1 Vegetative growth parameters:

One plant was randomly selected at tasseling from each plot. Growth analysis including, plant height (cm), number of leaves/plant shoot fresh weight (g)/plant and shoot dry weight (g)/plant

3. 3.1. 1. 1 Plant height (cm):

Plant height was measured from the soil surface (at the base of the plant) to the base of the tassel, in each plant.

3. 3.1. 1. 2 Number of leaves/plant:

The same plant was used to determine the number of leaves/plant in each plot.

3. 3.1. 1. 3 Shoot fresh weight (g)/plant):

The same plant was used to determine the shoot fresh weight/plant in each plot. The root was detached, then the shoot was weighed by using a triple beam balance (Mukhtar, 2006).

3. 3.1. 1. 4 Shoot dry weight (g)/plant):

The same plant was used to determine the shoot dry weight/plant in each plot. The shoot was dried in an oven at 80 °c for 48 hours and then weighed by using a triple beam balance (Mukhtar, 2006).

3.4 Statistical Analysis:

All the experiments were arranged in randomized complete block design (RCBD) with three replications. Analysis of variance (ANOVA) was carried out on data obtained as described by Gomez and Gomez using the statistical analysis system (SAS) computer package for SAS Institute Inc., 1990, to detect significant effects among the treatments and populations compared. Mean squares for treatments or populations were calculated. Simple statistics including mean, standard deviation, standard error and coefficient of variation (C. V.%) were also calculated.

CHAPTER 4

RESULTS

4- 1- Effect of weed interference on growth parameters:-

4- 1- 1- Effect on plant height (cm):-

Keeping the crop weed free for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly plant height as compared to the weedy full season treatment. Keeping the crop weed free for10 weeks after planting gave plant height comparable to the weed free full season treatment (table 1). Allowing weeds to compete with the crop for 2, 4, 6 weeks after planting and the weed free full season treatment increased significantly plant height as compared to the weedy full season treatment while allowing weeds to compete with the crop for 8 and 10 weeks after planting gave plant height comparable to the weedy full season treatment (table 1). Allowing weeds to compete with the crop for 2, 4, 6, 8 and 10 weeks after planting reduced significantly plant height as compared to the weeds free full season treatment (table 1)

Table 1: Influence of duration of weed interference on plant height (cm) during summer season 2017

Treatments	Plant height (cm)
Weed free for 2 weeks	29.30c
Weed free for 4 weeks	30.30c
Weed free for 6 weeks	30.30c
Weed free for 8 weeks	32.70c
Weed free for 10 weeks	37.70ab
Weedy for 2 weeks	35.00b
Weedy for 4 weeks	32.00c
Weedy for 6 weeks	30.70c
Weedy for 8 weeks	21.00d
Weedy for 10 weeks	20.70d
Weed free full season	39.30a
Weedy full season	20.30d
C. V. %	10.56
S. E.±	5.60

-Means with the same letters in the same column are not significantly different at 0.05 level of probability according to DMRT.

4- 1- 2- Effect on number of leaves/plant:-

Keeping the crop weed free for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly number of leaves/plant as compared to the weedy full season treatment.(table 2). Allowing weeds to compete with the crop for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly number of leaves/plant as compared to the weedy full season treatment. Allowing weeds to compete with the crop for 4 weeks after planting gave number of leaves/plant comparable to the weed free full season treatment (table 2).

Table 2: Influence of duration of weed interference on number of leaves / plant during summer season 2017

Treatments	Number of leaves / plant
Weed free for 2 weeks	6.90b
Weed free for 4 weeks	6.80b
Weed free for 6 weeks	7.00b
Weed free for 8 weeks	7..00b
Weed free for 10 weeks	7.70b
Weedy for 2 weeks	7.70b
Weedy for 4 weeks	8.70ab
Weedy for 6 weeks	7.70b
Weedy for 8 weeks	7.30b
Weedy for 10 weeks	7.00b
Weed free full season	9.30a
Weedy full season	6.00c
C. V. %	7.20
S. E.±	2.54

-Means with the same letters in the same column are not significantly different at 0.05 level of probability according to DMRT.

4- 1- 3- Effect on shoot fresh weight (g)/plant:-

Keeping the crop weed free for 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly

shoot fresh weight (g)/ plant as compared to the weedy full season treatment.(table 3). Keeping the crop weed free for 2 weeks after planting gave shoot fresh weight (g)/ plant comparable to the weedy full season treatment while keeping the crop weed free for 10 weeks after planting gave shoot fresh weight (g)/ plant comparable to the weed free full season treatment.(table 3). Allowing weeds to compete with the crop for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly shoot fresh weight (g)/ plant as compared to the weedy full season treatment. (table 3) Allowing weeds to compete with the crop for 2 weeks after planting gave shoot fresh weight (g)/ plant comparable to the weed free full season treatment (table 3).

Table 3: Influence of duration of weed interference on fresh weight (g) / plant during summer season 2017

Treatments	Fresh weight (g) / plant
Weed free for 2 weeks	8.10e
Weed free for 4 weeks	13.90d
Weed free for 6 weeks	16.50d
Weed free for 8 weeks	21.13c
Weed free for 10 weeks	32.40a
Weedy for 2 weeks	33.70a
Weedy for 4 weeks	30.00ab
Weedy for 6 weeks	27.50c
Weedy for 8 weeks	27.00c
Weedy for 10 weeks	19.70d
Weed free full season	35.10a
Weedy full season	8.60e
C. V. %	16.63
S. E.±	4.54

-Means with the same letters in the same column are not significantly different at 0.05 level of probability according to DMRT.

4- 1- 4- Effect on shoot fresh weight (g)/plant:-

Keeping the crop weed free for 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly shoot dry weight (g)/ plant as compared to the weedy full season treatment.(table 4). Keeping the crop weed free for 2 weeks after planting gave shoot dry weight (g)/ plant comparable to the weedy full season treatment while keeping the crop weed free for 10 weeks after planting gave shoot dry weight (g)/ plant comparable to the weed free full season treatment.(table 4). Allowing weeds to compete with the crop for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly shoot dry weight (g)/ plant as compared to the weedy full season treatment. (table 4).

Allowing weeds to compete with the crop for 2 weeks after planting gave shoot dry weight (g)/ plant comparable to the weed free full season treatment (table 4).

Table 4: Influence of duration of weed interference on dry weight (g)/ plant during summer season 2017

Treatments	Dry weight (g) / plant
Weed free for 2 weeks	4.80e
Weed free for 4 weeks	8.30d
Weed free for 6 weeks	11.10d
Weed free for 8 weeks	14.80c
Weed free for 10 weeks	26.80a
Weedy for 2 weeks	28.30a
Weedy for 4 weeks	20.80ab
Weedy for 6 weeks	18.50c
Weedy for 8 weeks	19.00c
Weedy for 10 weeks	12.70d
Weed free full season	27.70a
Weedy full season	5.90e
C. V. %	21.90
S. E.±	34.60

-Means with the same letters in the same column are not significantly different at 0.05 level of probability according to DMRT.

Results of this investigation showed that maize growth parameters which includes plant height (cm), number of leaves/plant, shoot fresh weight (g)/plant and shoot dry weight (g)/plant reduced when the duration of weed infested period

increased and increased when the duration of weed infested period decreased.

From the results of these studies it can be concluded that, a long weed-free duration is enough to provide high growth parameters.

Although maize growth parameters was increased in all weed control periods, these increases were positively related with prolonged weed free durations. The highest growth parameters was provided from pots in which weeds were left for the shortest period, from emergence.

CHAPTER 5

DISCUSSION

5- 1- Effect of weed interference on growth parameters:-

5- 1- 1- Effect on plant height (cm):-

Keeping the crop weed free for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly plant height as compared to the weedy full season treatment. Keeping the crop weed free for10 weeks after planting gave plant height comparable to the weed free full season treatment. Allowing weeds to compete with the crop for 2, 4, 6 weeks after planting and the weed free full season treatment increased significantly plant height as compared to the weedy full season treatment while allowing weeds to compete with the crop for 8 and 10 weeks after planting gave plant height comparable to the weedy full season treatment . Allowing weeds to compete with the crop for 2, 4, 6, 8 and 10 weeks after planting reduced significantly plant height as compared to the weeds free full season treatment.

5- 1- 2- Effect on number of leaves/plant:-

Keeping the crop weed free for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly number of leaves/plant as compared to the weedy full season treatment. Allowing weeds to compete with the crop for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly number of leaves/plant as compared to the weedy full season treatment.

Allowing weeds to compete with the crop for 4 weeks after planting gave number of leaves/plant comparable to the weed free full season treatment.

5- 1- 3- Effect on shoot fresh weight (g)/plant:-

Keeping the crop weed free for 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly shoot fresh weight (g)/ plant as compared to the weedy full season treatment. Keeping the crop weed free for 2 weeks after planting gave shoot fresh weight (g)/ plant comparable to the weedy full season treatment while keeping the crop weed free for 10 weeks after planting gave shoot fresh weight (g)/ plant

comparable to the weed free full season treatment. Allowing weeds to compete with the crop for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly shoot fresh weight (g)/ plant as compared to the weedy full season treatment.

Allowing weeds to compete with the crop for 2 weeks after planting gave shoot fresh weight (g)/ plant comparable to the weed free full season treatment.

5- 1- 4- Effect on shoot dry weight (g)/plant:-

Keeping the crop weed free for 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly shoot dry weight (g)/ plant as compared to the weedy full season treatment. Keeping the crop weed free for 2 weeks after planting gave shoot dry weight (g)/ plant comparable to the weedy full season treatment while keeping the crop weed free for 10 weeks after planting gave shoot dry weight (g)/ plant comparable to the weed free full season treatment. Allowing weeds to compete with the crop for 2, 4, 6, 8, 10 weeks after planting and the weed free full season treatment increased significantly shoot dry

weight (g)/ plant as compared to the weedy full season treatment.

Allowing weeds to compete with the crop for 2 weeks after planting gave shoot dry weight (g)/ plant comparable to the weed free full season treatment.

Results of this investigation showed that maize growth parameters which includes plant height (cm), number of leaves/plant, shoot fresh weight (g)/plant and shoot dry weight (g)/plant reduced when the duration of weed infested period increased and increased when the duration of weed infested period decreased. This increase is probably due to the removal of weeds which compete with the maize crop for essential mineral nutrients, water and light. This result is most probably due to the beneficial effects of removal of weeds which enabled the crop to maximize the use of the available resources in soil, light and water. Similar result was reported by Worwick and Black (1988).These results could be attributed to the presence of weeds which compete with the maize crop for essential mineral

nutrients, water and light which reduced plant growth parameters.

Also this result was mentioned by in line Ishag (1979),

From the results of these studies it can be concluded that, a long weed-free duration is enough to provide high growth parameters.

Although maize growth parameters was increased in all weed control periods, these increases were positively related with prolonged weed free durations. The highest growth parameters was provided from pots in which weeds were left for the shortest period, from emergence.

CONCLUSIONS

The following conclusions were obtained:-

1- Unrestricted weed growth significantly reduced maize growth parameters by in both summer seasons.

2- Maize growth parameters which includes plant height (cm), number of leaves/plant, shoot fresh weight (g)/plant and shoot dry weight (g)/plant reduced when the duration of weed infested period increased and increased when the duration of weed infested period decreased.

3- A long weed-free duration is enough to provide high growth parameters.

4- Although maize growth parameters was increased in all weed control periods, these increases were positively related with prolonged weed free durations.

5- The highest growth parameters was provided from pots in which weeds were left for the shortest period, from emergence.

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