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Growth and Yield of Parameters of Soybean *(Glycine max* (L.) Merrill) as Affected by Rates of Starforce and Bentaforce at Bali, Taraba State

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Abstract: **Field experiment was conducted at the Teaching and Research Farm of the Department of Agricultural Technology, Federal Polytechnic Bali, Taraba State in 2018 cropping season with the view to find out the influence of starforce and bentaforce rates on the growth and yield parameters of soybean. The experiment was carried out using split plot design with spacing assign to main plot treatment and herbicides rates as sub plot treatment. The main plot treatments were: 35 x 20 cm, 40 x 25 cm, 45 x 30 cm and 50 x 35 cm and the sub plot treatments were: 0 kg a. i. /ha, 4 kg a. i. /ha, 6 kg a. i. /ha and 8 kg a. i. /ha replicated four times. Result obtained showed that herbicides rates of 6 and 8 kg a. i. /ha performed better in all the parameters measured during the experiment. This was because the rates control weeds better allowing plants to use growth resources without competition. When plants were well spaced and weeded free, there will be no competition between to plants and weeds. All the parameters measured performed better at higher dose indicating that the dose were optimum dose for weed control in Bali. Therefore, considering the optimum rates in this research, farmers should adopt 6-8 kg a. i. /ha of post-emergence herbicides (starforce and bentaforce) for weed control in Bali that leads to higher growth of soybean plant and subsequently leading higher yields.**

Keywords: **growth, yield, parameters, starforce and bentaforce.**

1. INTRODUCTION

Soybeans (*Glycine max* (L.) Merrill), belongs to the family leguminoseae. It is believed to have originated in Eastern Asia, probably in North and Central China but now have spread in many parts of the world including Nigeria (F. A. O., 1988 and F. A. O., 2001). It is herbaceous annual legume, usually erect, bushy and rather leafy which originated in China. The crop has a relatively short growth duration due to its sensitivity to short day length in the tropics (Norman *et al*., 1995). Soybeans is widely distributed in most parts of the world, the crop has a lot of potential in Africa (Steve and Jonathan, 2001). It is frost sensitive, thrive best on sandy or clay loams and alluvial soils of good fertility and the optimum soil P^H for soybean cultivation ranges from 6.0-6.5 (Adetiloye *et al*., 2000).

Soybeans is primarily an industrial crop cultivated for oil and protein. Despite the relatively low oil content of the seed, it is still the largest source of edible oil and account for roughly 50% of the total oil seeds production of the world (F. A. O., 1988). It is generally known that the seed of soybean contains the highest and richest protein among oil cultivated legumes (F. A. O., 1989). Worldwide interest and attention in soybean is mainly due to its high nutritional value and seed protein content (Tiamigu and Idowu, 2001). Soybean has a composition of protein content of over 40%, edible vegetable oil content of 20.5%, carbohydrates content of about 30.5%, a total sugar content of about 10% and an ash content of about 5% (IITA, 1993). Apart from it primarily use as source of oil, some soybeans products enhanced nutritional qualities have been developed and are available in the market. These incudes soy milk (100 % soybeans), soy oil (100 % soybeans), biscuits (100 % soybeans) and cassoy (30 % soybeans) (Di *et al.*, 1996).

Weed interference have identified as the major factor responsible for low seed yield of crops (Adeyemo *et al*., 1992). The constraints imposed by weeds to crops has been well documented (Jain *et al*., 1985). The traditional methods of weeds control, namely: hoe weeding is the commonest method of weed control by farmers in the Sudan savanna zone of Nigeria. This method is not only labour intensive, expensive and strenuous, but can also cause damage to the growing branches and new roots of plants. In addition to high cost, labour availability is uncertain thus making timeless of weeding difficult to attain, leading to greater yield loss (Adigun and Lagoke, 2003)

Weeds are more harmful pests of field crops as compared to insects, fungi, rodents, storage pests etc. as far as their losses to crop produce are concerned (Walia, 2010). Weeds compete on growth factors like fertilizers, moisture, space, light etc. with crops throughout their life period. Depending upon the type and density of these weeds, a tremendous loss is caused to the crop in which these are associated (Jayakumar and Jagannathan, 2007). Losses due to weeds have been one of the major limiting factors in soybean production. Weeds compete with crop for light, moisture, and nutrients, with early-season competition being the most critical. The grain yield reduction due to the weed infestation in soybean may be up to 31-84% (Kachroo *et al*., 2003). Most of the yield reduction due to weed competition occurs during the first six weeks after planting; therefore, major emphasis on weed control should be given during this period. Good soybean weed control involves utilizing all methods available and combining them in an integrated weed management system; but considering the present day labour scarcity and their higher wages for cultural and mechanical weed control, the economics and feasibility of soybean cultivation is quit disturbed. Hence the emphasis should be given to adapt the chemical methods of weed control to solve the problem of minimum available labour and their high cost.

Small holder farmers often face a number of problems related to herbicides use, due to either an inadequate rate of herbicide being applied or herbicide being applied too late to provide good effect on the weed. A major cause of this is likely to be the serious lack of information available to the farmer and lack of technical know-how (Johnson, 1996). Chemical weed control through responsible use of herbicides technology such that will guarantee efficient management of weeds is emerging in our farming system. The advantages derivable from the use of herbicide generally can easily be marred by hazards from misuse and outright abuse of the herbicides. Most active ingredients may be only give effective control of certain group of weeds at specific rate and growth stage (Ndarabu and Anudu, 2010).

In view of the rapidly expanding population in Nigeria and the general acceptability of soybean as a popular stable food among small scale farmers and as source of raw materials for our industries, there is the need to increase production through appropriate rate of post-emergence herbicides to ensure optimal production. Hence the need for this research work with the following objectives:

1. To determine the effect of starforece and bentaforce rates on the growth and yield parameters of soybean
2. To determine appropriate rate of starforce and bentaforce on the growth and yield parameters of soybean.

2. METHODOLOGY OF THE STUDY

Experimental Site

Field experiment was conducted at the Teaching and Research Farm of the Department of Agricultural Technology, Federal Polytechnic Bali, Taraba State in 2018 cropping season. The study area is located within latitude 7^o 12' to 9^o 00' N of the equator and longitude 10^o 00' to 12^o 00' E of the meridian (Atlas, 2006). It has land mass of about 10,000 M^2 and lies within the guinea savanna ecological zone of Nigeria. The annual rainfall ranges from 750 mm to 1100 mm. the temperature ranges between 22^o c to 40^o c. the soil is dominantly of ferruginous tropical type that lies on sandy parent materials (Dada *et al*., 2006).

Land preparation

The land was ploughed using tractor and was harrowed using tractor and leveled using hoe. The experimental field was marked out into 16 main plots of 2 m x 12 m including the walk ways and 80 sub plots of 2 m x 2 m each giving the total land area of 26 m x 26 m. Walk ways of 1 m was created between the main plots and sub plots. Sowing of crop was by direct seeding. Three (3) seeds was sown per hole and later thin to 2 plants per stand at three weeks after sowing. Post emergence herbicides was applied four (4) weeks after sowing to control weeds.

Experimental Design and Treatment

The experimental design used was split plot. The main treatment was four (4) row spacing (35 cm x 20 cm, 40 cm x 25 cm, 45 cm x 30 cm and 50 cm x 35 cm) and sub plot treatment was four (4) rates of starforce and bentaforce (0 kg a.i. /ha, 4 kg a. I /ha, 6 kg a. i. /ha and 8 kg a. i. /ha). The treatments were replicated four times. The variety was tumako cultivar.

Data collected

Plant height= Plant height was measured from the base of the stem to the tip of the plant. This was done at an interval of 3 weeks from 10 stands in a plot beginning from 30 days after sowing and the data collected was averaged.

Number of leaves per plant= Number of leaves per plant was counted per plant from 10 stands in a plot beginning from 30 days after sowing and data collected was averaged.

Number of branches per plant= number of branches per plant were counted per plant from 10 stands per plot beginning from 30 days after sowing and the average was determined.

Number of pods per plant= Number of pods per plant was obtained by counting the pods /plant from 10 stands in a plot and the number obtained was averaged to get the number of pods per plant.

Pods weight per plant= Pods weight per plant was determined by weighing the pods per plant from 10 stands per plot and the average was determined.

Hundred seed weight= hundred seed weight was weighed on electrical weighing balance per plot and the weight obtained was recorded in grams.

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) using statistical model of "Factorial Designs-Explicitly Assessing Interactions. The means were separated using Least Significant Difference (LSD) at 5% level of probability.

3. RESULTS AND DISCUSSION

Table 1 shows effect of starforce and bentaforce rates on growth parameters of soybean in 2018 cropping season. Effect of starforce and bentaforce rates on plant height in 2018 cropping season shows that all the rates produced the same plant height including the control. The shortest plants were obtained at the rate of 6 kg a. i. /ha. The same plant height obtained was as a result of the herbicides did not affect plant height because the dose were not over dose. The result obtained concurred with the result of Daniel, *et al.*, (1993) who reported that soybean yields were similar at all the herbicides rates.

Effect of starforce and bentaforce rates on number leaves per plant in 2018 cropping season are presented in Table 1. Effect of starforce and bentaforce rates on number of leaves shows that 6 kg a. i. /ha and 8 kg a. i. /ha produced more number of leaves with the values of 2.9 and 3.0 respectively. The highest number of leaves obtained at these rates was because the rates control weeds better leading to high plant growth and there after more number of leaves as reported by Hosseini *et al.*, (2001) that soybean produced more number of branches per plant at low plant densities subsequently more leaves. Smita, *et al.*, (2015) reported that different weed control treatments were found to be significantly affecting to various growth and yield attributing characters in soybean over control treatment.

Effect of starforce and bentaforce rates on number of branches per plant in 2018 cropping season are presented in Table 1. Effect of starfoece and bentaforce rates on number of branches shows that 6 and 8 kg a. i. /ha produced more branches with value of 2.3. More branches produced at these rates was because plants experienced less competition with weeds because of proper weed control at these rates leading to healthy growth of plants. The yield and yield attributing characters, viz., branches and pods per plant were significantly influenced by different weed control treatments. The highest values of these parameters over control were higher in weed-free. Higher level of these parameters could be attributed to low competition stress of crop with weed plants (Rakesh *at al.*, 2010). Charles, (2012) reported that when the number of branches with pods was counted at harvest, it was found that the degree of branching varied with cultivars, planting dates, row widths, and herbicide treatments. The effects of herbicide treatments and row spacing on branching may be related to the efficiency of weed control.

Table 1: Effect of starforce and bentaforce on plant growth parameters during 2018 cropping season in Bali, Taraba State

Treatment	Plant Height (cm)	Number of Leaves	Number of Branches/Plant
Rates of starforce and bentaforce			
0 kg a. i. /ha	3.5	2.8	1.9
4 kg a. i./ha	3.5	2.8	1.8
6 kg a. i. /ha	3.3	2.9	2.3
8 kg a. i. /ha	3.5	3.0	2.3
Mean	3.5	2.9	2.07
(P of F)	0.024	0.1237	7.16
LSD	0.133	0.242	0.268

Key:

LSD=Least Significance Difference

Cm=Centimeter

Table 2 shows effect of starforce and bentaforce rates on yield parameters of soybean in 2018 cropping season. Effect starforce and bentaforce rates on pod weight per plant in 2018 cropping season as presented in Table 2 shows that 4 and 8 kg a. i. /ha produced heavier pod weight per plant with the value of 4.7 g followed by control and 6 kg a. i. /ha. Heavier pod weight produced by these rates was as a result of proper weed control by these rates which encourages the production of bigger seeds in the pods because of less competition among the plants and weeds. Similar results were earlier reported by Kalhapure *et al.*, (2011). Imazethapyr 0.100kg/ha + quizalofop-ethyl 0.075 kg/ha as post-emergence was recorded the highest 100 seed weight, seed yield and straw yield per hectare, gross return, net return and B;C ratio as compared to all other treatments. The improvement in yield and economical parameters which resulted from better weed control with different weed management practices in soybean was also recorded by Sharma (2000)

Effect of starforce and bentaforce rates on number of pods per plant in 2018 cropping season are presented in Table 2. Effect of starforce and bentaforce rates on number of pods in 2018 cropping season shows that 8 kg a. i. /ha produced more number of pods than other rates followed by 4 kg a. i. /ha with values of 11.3 and 11.2 respectively. The production of more pods per plant at these rates shows that weeds has been properly controlled leading high growth of soybean plant and pod number per plant. Rakesh *et al.*, (2010) reported that yield and yield attributing characters, viz., branches and pods per plant were significantly influenced by different weed control treatments. The highest values of these parameters over control were higher in weed-free plots. Higher level of these parameters could be attributed to low competition stress of crop with plants. Charles (2012) reported that both herbicides increased the number of pods on Adelphia but on Treflan treatments raised pod numbers of Amsoy and Wayne.

Effect of starforce and bentaforce rates on hundred seed weight in 2018 cropping season are presented in Table 2. Effect of starforce and bentaforce rates on hundred seed weight in 2018 cropping season shows that 6 and 8 kg a. i. /ha produced the highest 100 seed weight with the value of 2.5 g. The highest seed weight obtained at 6 and 8 kg a. i. /ha shows that herbicides at this rates control weeds better leading heavier seeds. Rakesh *at al.*, (2010) reported that the lower yield obtained was as a result of higher infestation of broad leaved weeds and their high dry matter accumulation in those plots and less effectiveness against broad leaved weeds. Langton *et al.*, (1997) reported that weed competition reduced the soybean yield by 15-18%

Table 2: Effect of starfoece and bentaforce rates on yield parameters during 2018 cropping season in Bali, Taraba State

Treatment	Pod Weight /plant (g)	Number of Pods /plant	Hundred Seed Weight (g)
Starforce and bentaforce rates			
0 kg a.i. /ha	4.6	9.1	2.4
4 kg a.i./ha	4.7	11.2	2.4
6 kg a.i. /ha	4.6	11.0	2.5
8 kg a.i. /ha	4.7	11.3	2.5
Mean	44.643	3.45	2.5
(P of F)	0.301	2.03	0.12
LSD	0.184	0.133	0.042

Key:

LSD= Least significance difference

Cm= centimeter

Table 3 shows nutritional value of soybean in Bali, Taraba State. The table shows that soybean grown in Bali contained the following nutritional values: Carbohydrate= 32%, oil= 24%, protein= 38%. Also, complex vitamins like A, B, B1, C, D and E are present and minerals obtained in soybean in Bali are: Ca, K, Mg and P. this indicated that soybean have nutritional values required for human consumption and industries. Leyla *et al.*, (2016) reported that the differences between the plant densities for the oil yield comes from seed yield differences.

Table 3: Nutritional Value of soybean in Bali Taraba State

Carbohydrate =	32%
Oil=	24%
Protein=	38%
Complex Vitamins=	(A, B, B1, C, D, E)
Minerals=	Ca, K, Mg, P easily soluble

4. CONCLUSION

The results of this study demonstrate the benefits of herbicides rates on the growth and yield parameters of soybean. The results indicated that herbicides application and use increase growth and yield parameters of soybean when applied using correct dose. Herbicides rates at higher dose proved to control weeds better leading to better growth of soybean and subsequently higher yield. This was as a result of less competition between plants and weeds for growth resources (light, space, water and nutrient). All the parameters measured performed better when herbicides were applied at higher rates. Because of this, small holder farmers should adopt the use of herbicides at appropriate rate and timing so as to ensure higher soybean production in Bali and its surrounding environment.

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