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THE PERFORMANCE OF SOYBEAN (*GLYCINE MAX* (L.) MERRILL) UNDER VARYING WEEDING REGIMES IN SOUTH WESTERN NIGERIA

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Abstract. Two field trials were conducted at the Teaching and Research Farm, the University of Ibadan, Ibadan, in 1999 and 2001, to study the performance of two soybean cultivars subjected to varying weeding regimes, viz: no weeding, weeding at 2 and 4 weeks after sowing (WAS), 2 and 6 WAS and 2 and 8 WAS. The experiments were a factorial combination of variety and weeding regimes in randomized complete block design with four replications. Data were taken at maturity on some vegetative, dry matter and yield parameters. The competing weeds were also identified, sampled, dried and weighed. Data were analyzed using ANOVA and means separated by LSD (P=0.05). Results showed that weeds did not adversely affect the performance of the two soybean varieties at 2 WAS. In addition, two weedings were adequate for the two soybean varieties but the interval of weeding was absolutely important in yield determination. The growth stage when these weeds prove to be harmful competition on soybeans, as evidenced from the results of this study, was between 4 and 6 WAS. The results also showed that plots left unwedded inevitably had the highest yield reduction in both varieties. On the other hand, plots weeded at 2 and 6 WAS showed the best performance in all aspects for both varieties of soybean, than other weeding regimes. It is clear from this study, therefore, that weeding at 2 and 6 WAS ensured that most parts of vegetative and reproductive stages were weed-free, so that in conclusion, weeding soybean crop twice is appropriate using the 2 and 6 WAS sequence, for optimum performance in south west Nigeria.

Key words: Soybean, weeds, weeding intervals, soybean yield, varieties

INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) is an oil crop, which is increasing in popularity in Nigeria. It is rich in protein and used to fortify various foods, in order to improve their nutritional quality (IITA, 1990). Soybean is also important in the supply of high quality animal feed (Miller et al 1997). Soybean production is quickly becoming popular in Nigeria. From 1979-1989, annual production rose from about 73,000 to 146,000 metric tones (Wudiri, 1990). It has been estimated that 1.6 million metric tones are needed annually to satisfy domestic and industrial needs (Mamman, 1990). There is therefore a wide margin between what is needed and what is currently produced.

The performance of crops during cultivation is a function of crop genetic composition and environmental factors. Therefore, to achieve desired increase in soybean production, both biotic and abiotic factors must be adequate and favourable. Consequently, temperature, soil

condition and other abiotic factors must be optimum. Similarly, diseases, pathogens and pests including weeds should be kept under check for optimum crop yield.

One major pest of crops in the tropics is weed. Weeds reportedly reduce yield of soybean by up to 12-80%, depending on density and variety (Burnside, 1972; Berentine, 1974; Eaton et al., 1976; Haygood et al., 1980; Zimdahl, 1980; Decker and Meggitt, 1983). An average of 53% yield reduction has been reported if weeds are left uncontrolled in soybean crops (Akobundu, 1987). Generally, the longer the duration of weed interference, the strongest is the depressive effect on soybean leaf number and stem height. Days to flowering in soybean is also affected by weed interference. The longer the weed interference, the longer the crop takes to flower (Ayeni et al., 1992). However, weed interference, two weeks after sowing, had no significant effect on soybean leaf number and stem height (Ayeni, 1990).

Farmers generally weed their soybean fields twice before crop maturity, considering the cost of labour. The effectiveness of the two weedings in ensuring optimum yield of soybean might depend on the time interval between the two weeding, on one hand and the maturity period of the cultivated variety on the other hand. It is therefore of interest to study how two weedings carried out at different time intervals will influence the performance of soybean. The objective of the study, therefore, was to determine and evaluate the performance of early and late maturing varieties of soybean cultivated under two weeding regimes carried out at different time intervals.

MATERIAL AND METHODS

Two field trials were carried out at the teaching and Research farm, the University of Ibadan, Ibadan, Nigeria between August-December 1999 and July-November 2001. Each experiment was a factorial of variety and weeding regimes in a randomized complete block design with four replications. The two soybean varieties used for the study TGX 1485-ID (early maturing) and TGX 1019-2EBC (late maturing), were obtained from the International Institute of Tropical Agriculture (IITA) Ibadan. Four weeding regimes were applied, these were: no weeding, 2 and 4 weeks after sowing (WAS), 2 and 6 WAS and 2 and 8 WAS. Land preparation was done by removing the vegetation manually followed by ploughing. The experimental plot measured 18 m x 25 m. Each of the four replications measured 4.8 m x 6 m and a plot within each replicate measured 2.4 m x 3 m. The eight treatments were randomly allotted to the plots within each block using the table of random numbers.

The seeds of the soybean varieties were sown on the 5th of August, 1999 in the first trial. The spacing was 60 cm x 5 cm. Two seeds were sown per hole and the resulting seedlings were thinned to 1 plant per stand 2 WAS.

Fertilizer, N.P.K (20:10:10), was applied to the soil at the rate of 50 kg N ha^{-1}, 2 WAS. To scare birds, especially pigeon from pecking the hypocotyls of the seedlings, scarecrows of human effigy were put in place. Also seeds mixed properly with Furadan granules were also placed along edges to bait the birds. The weeds encountered on the experimental plot included annual grasses such as *Digiteria horizontalis, Eleusine indica Eragrostis tenella, Acroceras Zizanoides.* Annual broad leaves included *Tithonia diversifolia, Euphobia hirta, Euphobia heterophylla, Phylantus amarus, Physalis angulata, Commelina spp, Boerhavia diffusa.,* Perennial grasses included *Cynodon dactylon* and sedge was *Cyperus haspan.*

Weeding Regimes Treatments

At 2 WAS, all plots were weeded except control plots. Two weeks later, the plots to be weeded at 2 and 4 WAS were weeded. At 6 WAS, the plots to be weeded at 2 and 6 WAS were weeded and finally at 8 WAS the plots to be weeded at 2 and 8 WAS were weeded.

Sampling

Prior to weeding the plots, weeds were collected from each of the plots in order to determine the dry weight of the weeds. A 25 cm x 25 cm quadrate was placed systematically on each plot. The interval between 1 sample and the next was 1m each plot was sampled 4 times twice on each row.

After the imposition of the weeding treatments, samples of soybean plants were taken from the treated plots and data were taken on the following parameters: Number of leaves, leaf area (cm^2), plant height (cm), Number of nodes on the main stem, Number of branches. The soybean samples were separated into leaves, stem and roots and oven dried at 80^0C for 48 hours. The dried components were weighed using mettler balance 1210. The total dry weight was also calculated. At maturity, data were also taken on number of pods $plant^{-1}$, and pod dry weight $plant^{-1}$. The data obtained were subjected to ANOVA and means separated by LSD (P= 0.05)

2001 Trial

This involved the repetition of the 1999 trial. The land was cleared and debris removed. Ploughing was done and plots marked out using the dimension and techniques used in the 1999 trial. Planting was done on 25 July, 2001 and the resulting seedlings were thinned to 1 plant per stand. The cultural operations, fertilizer application, weeding regimes, sampling and data collection were done as carried out in 1999 trial. Weeds were sampled at 2, 4, 6 and 8 weeks after sowing. The data obtained were subjected to analysis of variance and means compared using LSD (P=0.05).

RESULTS AND DISCUSSION

In the two trials, the interactions between variety and weeding regimes were not significantly different for all parameters studied. This indicates that the two varieties responded similarly to the weeding regimes, and so only the results of the effects of variety and weeding regimes on soybean growth and yield parameters are presented.

Effect of variety on vegetative and reproductive parameters of soybeans subjected to varying weeding regimes in 1999

The result of this study showed that there were no significant differences in the values of the vegetative characters of the two soybean varieties. In this sense, the number of leaves, leaf area, number of branches, stem height as well as number of nodes of the two soybean varieties were not significantly different at 5% level of significance (Figure 1). Similarly, the dry weights and the number of pods produced by the two varieties were not significantly P= (0.05) different (Figures 2 and 3). This shows that differences in maturity period of the two soybean varieties did not significantly affect the growth and yield of the varieties used in this study.

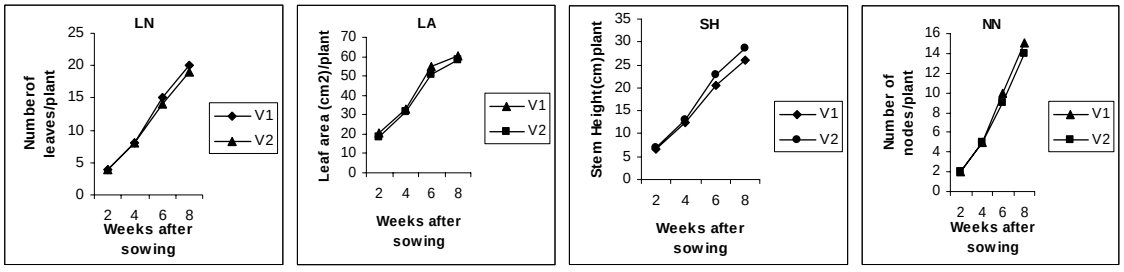

Figure 1. Effect of variety on vegetative characters of soybean subjected to varying weeding regimes on the field in 1999 (V1 = early maturing variety, V2 = Late maturing variety; I = LSD; P= 0.05)

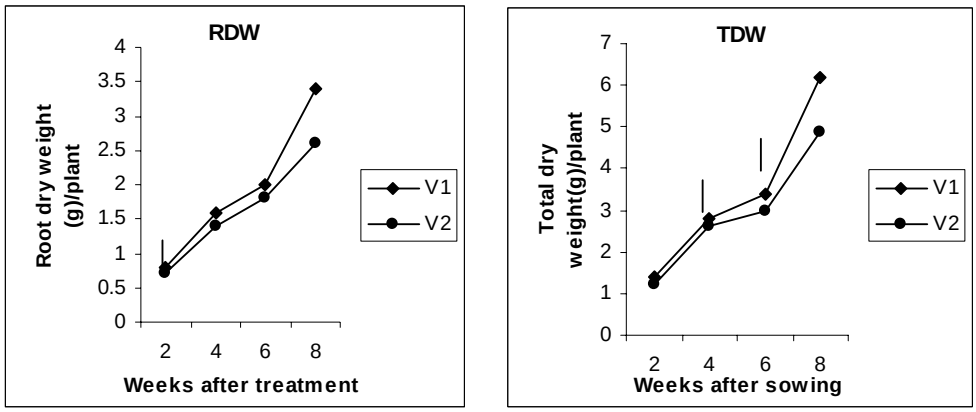

Figure 2. Effect of variety on some dry weight characters of soybean subjected to varying weeding regimes in 1999 (V1 = early maturing variety, V2 = late maturing variety; I=LSD; P= 0.05)

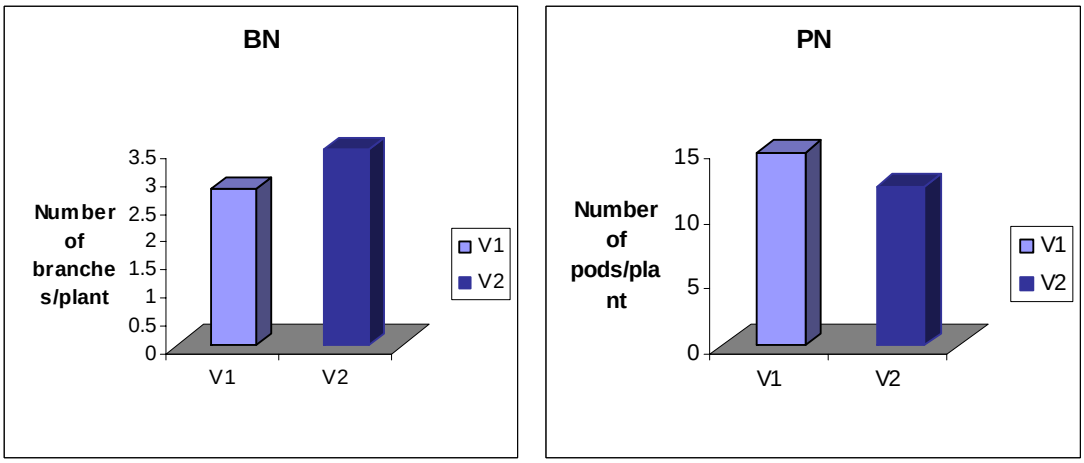

Figure 3. Effect of variety on number of pods and branches of soybean subjected to varying weeding regimes on the field, in 1999 (V1 = early maturing variety, V2 = late maturing variety; I=LSD; P=0.05)

Effect of weeding regimes on vegetative characters of the soybean

The results of this study showed that weeds had no effect on the soybean, 2 weeks after sowing, apparently because weeds just emerging after the clearing of vegetation before planting were still too young to have any appreciable impact on the young soybean plants. This agrees with the report of Bidwell (1974), Eaton et al. (1976), Oyekan et al. (1985) and Ayeni (1992) that related weed interference on soybean performance to the weed growth stages. However, weed interference thereafter drastically reduced growth.

The difference in vegetative characters of plants in weeded and unweeded plots became apparent at 8 weeks after sowing. At this time, plants in plots weeded at 2 and 4 weeks had significantly more leaves than plots weeded at 2 and 8 WAS. However, the plants in plots weeded at 2 and 6 WAS had significantly the highest number of leaves compared with plants in other plots (Figure 4).

There was no significant difference in the leaf areas and heights of plants subjected to different weeding regimes (Figure 4). However plants in weeded plots had higher values of leaf area, plant height and number of leaves than plants in unweeded plots.

In the 2001 trial, soybean plants had similar values of the vegetative parameters 2 WAS. They also had similar stem height, number of leaves and number of nodes 4 WAS.

However at 6 WAS, plants weeded at 2 and 4 and 2 and 6 WAS had similar number of leaves, nodes and leaf area which were significantly higher than other treatments. At this time, plants weeded at 2 and 4 WAS had the highest leaf area, leaf number and stem height. At 8 WAS, the results were similar to those obtained in 1999 with plants weeded at 2 and 6 WAS having the highest number of leaves, nodes, and leaf area while the control plants had the lowest number of these parameters (Figure 5).

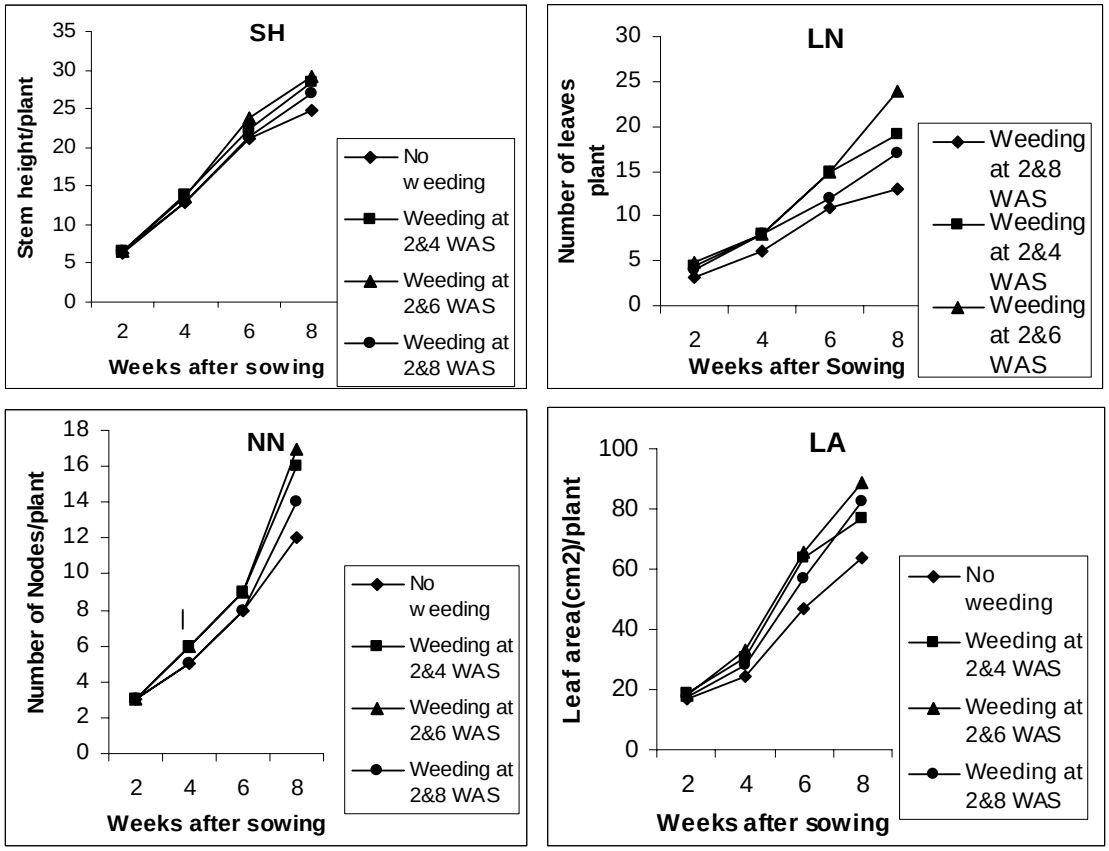

Figure 4. Effect of weeding regimes on vegetative characters of soybean grown on the field in 1999 (I= LSD; P=0.05)

There was no significant difference in the leaf areas and heights of plants subjected to different weeding regimes (Figure 4). However, plants in weeded plots had higher values of leaf area, plant height and number of leaves than plants in unweeded plots.

In 2001 trial, soybean plants had similar values of the vegetative parameters 2 WAS. They also had similar stem height, number of leaves and number of nodes 4 WAS. However at 6 WAS, plants weeded at 2 and 4 and 2 and 6 WAS had similar number of leaves, nodes and leaf area which were significantly higher than other treatments. At this time, plants weeded at 2 and 4 WAS had the highest leaf area, leaf number and stem height. At 8 WAS, the results were similar to those obtained in 1999 with plants weeded at 2 and 6 WAS having the highest number of leaves, nodes, and leaf area while the control plants had the lowest number of these parameters (Figure 5).

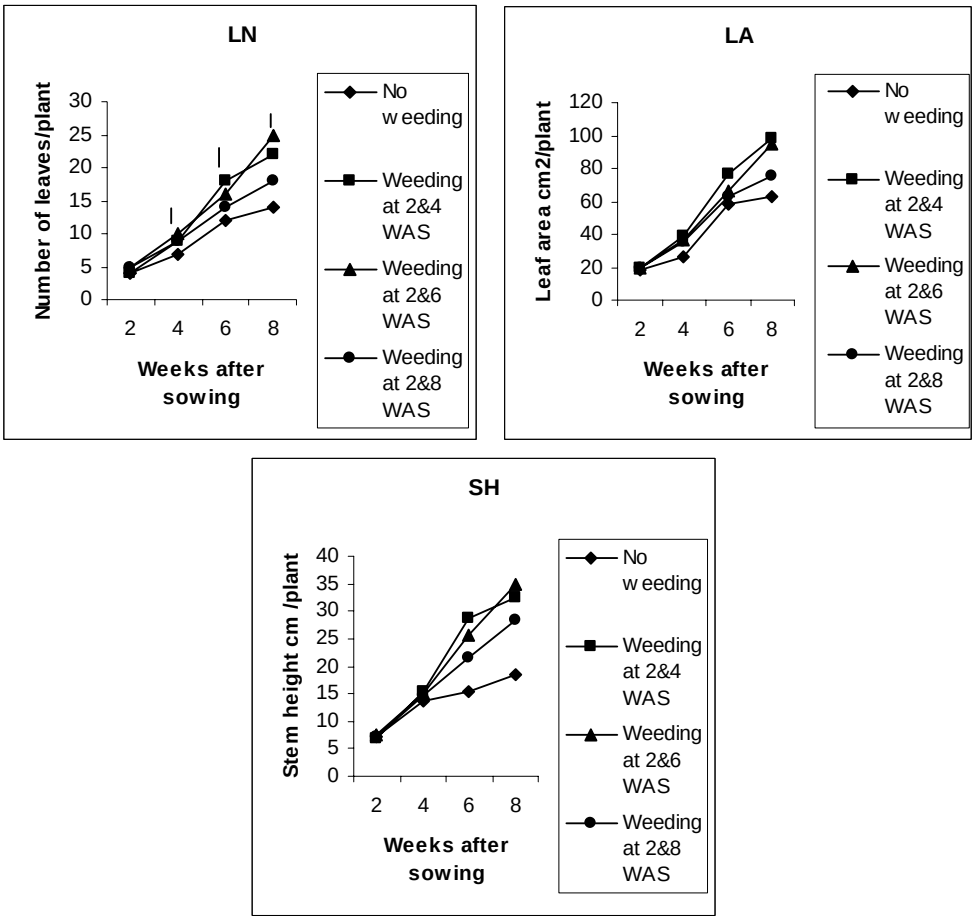

Figure 5. Effect of weeding regimes on some vegetative characters of soybean grown on the field in 2001 (I= LSD; P=0.05)

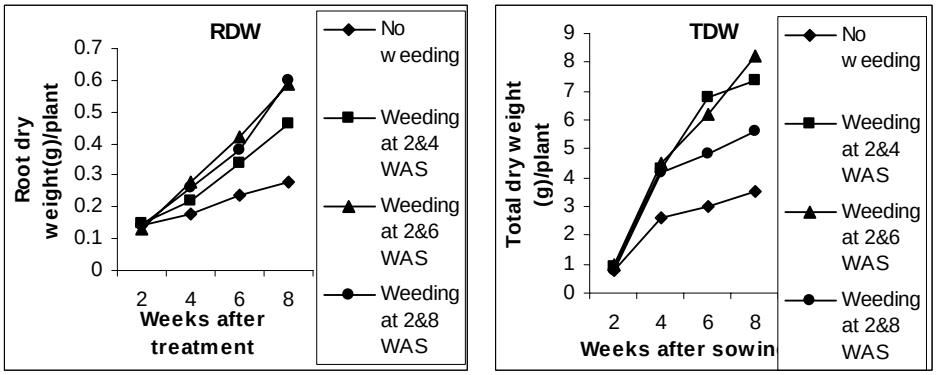

Figure 6. Effect of weeding regimes on dry weight characters of soybean grown on the field in 1999 (I= LSD; P=0.05)

Effect of weeding regimes on dry matter accumulation

There was no significant difference in the total dry weight of plants weeded at 2 and 4 weeks and at 2 and 6 WAS. Significant differences however existed between the dry weights of all weeded treatments and no weeding, with the any weeding treatment having plants with

the lowest total dry weight (Figure 6). In 2001, plants in the unweeded plots had the lowest total dry weight followed by plants weeded at 2 and 8 WAS. The weed dry weight followed the pattern observed in 1999 trial with the unweeded plots having, inevitably, the highest weed dry weight (Figure 8).

Effect of weeding regimes on soybean yield

Flowering was delayed in unweeded plots and so flowering in soybean was significantly delayed in unweeded plots compared to weeded plots. In addition, even though flowering was slightly delayed in plots weeded at 2 and 8 weeks, there was no significant difference in flowering days of plants weeded at 2 and 4, 2 and 6 and 2 and 8 weeks after sowing (Figure 7).

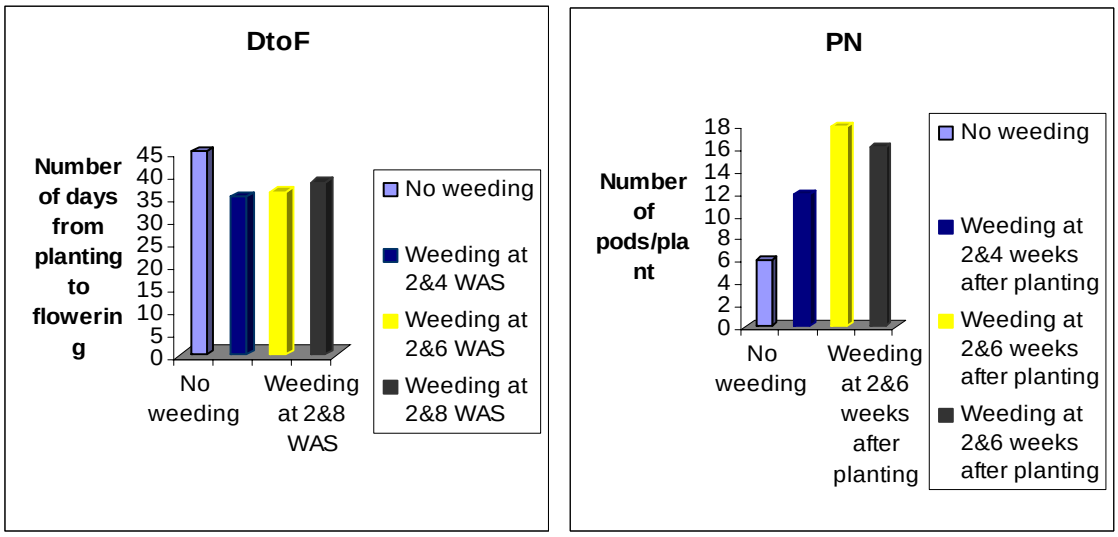

Figure 7. Effect of weeding regimes on flowering and number of pods of soybean at 8 WAS and at maturity, respectively, in 1999 (I= LSD (P=0.05))

The control weedy plot had significantly lower number of pods compared with weeded plots. The plant weeded at 2 and 6 weeks after sowing produced the highest number of pods compared with other weeding treatments (Figure 7). The plants weeded at 2 and 6 WAS had the highest number of pods which was not significantly different from that of plants weeded at 2 and 4 WAS but significantly higher than those of plants weeded at 2 and 8 WAS and the control plants. The pod dry weight also followed the same pattern of variation observed in pod number (Figure 8). The results of this study also showed that weeding soybean crop twice is adequate for both varieties. However the weeding interval is very important. In both varieties weeding at 2 and 6 weeks after sowing produced the best performance in respect of both vegetative and reproductive parameters than other weeding regimes. A cursory look at the weed spectrum encountered in this study showed that most of the weeds were ephemeral which reached the reproductive phase of their life cycle within four weeks of establishment. The reproductive stage is the phase when the greatest demand for resources, especially nutrient and water is made (Bidwell, 1974). This period corresponds to the time of weed removal at 2 and 6 weeks after sowing is carried out.

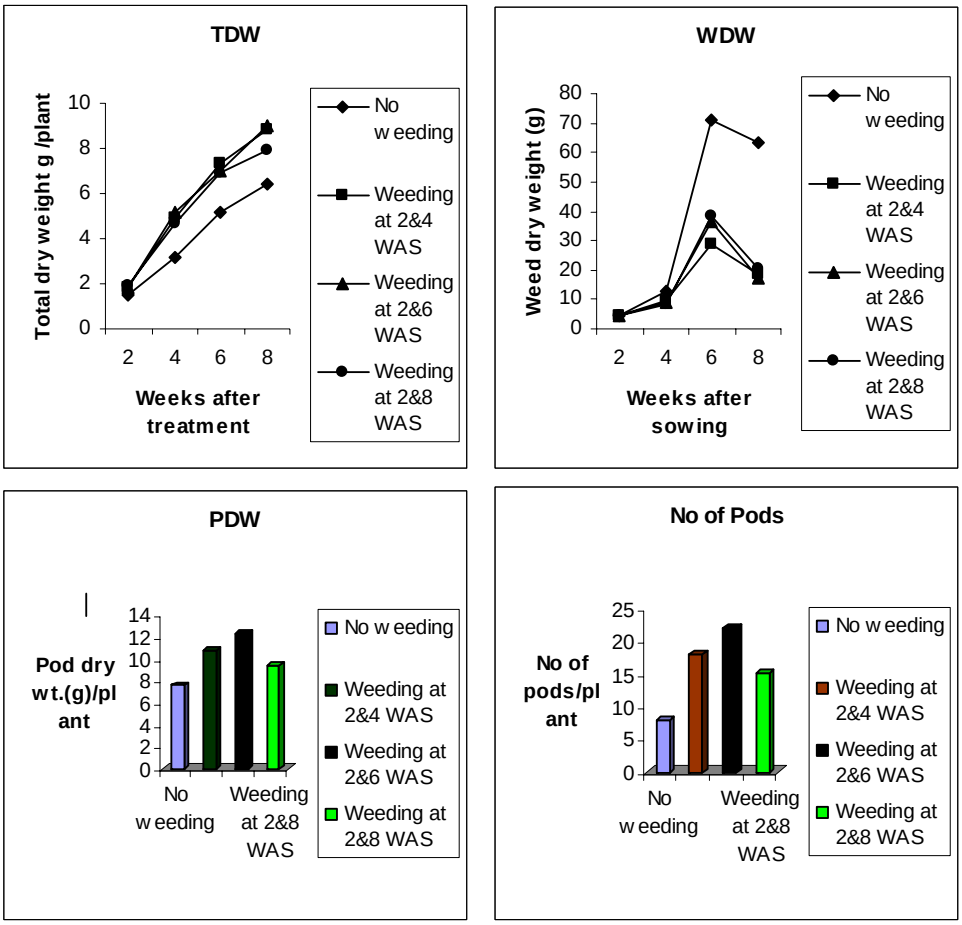

Figure 8. Effect of weeding regimes on number of pods and some dry weight characters of soybeans in 2001 (I= LSD; (P=0.05)

Weeding at 2 and 6 WAS showed trends similar to 2 and 8 weeks particularly in respect of leaf area stem height and total dry weight. This must have been so because at 6 and 8 weeks after sowing, the growth rate of ephemeral weeds had slowed down compared with the growth rate between 4 and 6 WAS, This is also in agreement with the observation of Ayeni et al. (1992). However, the difference between the two weeding regimes was that number of pods in weeding at 2 and 6 WAS was significantly higher than the number of pods at 2 and 8 WAS. Hence weeding at 2 and 6 weeks for both varieties supported higher pod production.

The 2001 experiment showed that weeding at 2 and 4 weeks actually led to the production of plants with the highest values of vegetative characters at 6 WAS but not at 8 WAS because weeds that developed between 4 and 8 WAS were beginning to affect the crop. Similarly, weeding at 2 and 6 WAS showed that even though the interval was still 4 weeks, the weeding done at the 6th week after sowing still fell within the vegetative phase of the crop so that the plants were able to grow reproductively under a more or less weed-free condition. This probably accounted for the overall best performance of plants weeded at 2 and 6 WAS. Furthermore, the plants weeded at 2 and 4 WAS had the latter part of the vegetative growth and the entire reproductive phase exposed to weed competition. Similarly, plants weeded at 2 and 8 WAS had a large portion of vegetative growth attacked by weeds which must have weakened the plants. So the balance of keeping both vegetative and reproductive phases of

growth weed-free was critical to the performance of soybean and this was provided by weeding the crop at 2 and 6 WAS.

Weeds Encountered

The weeds encountered in the experimental plots were identified and samples obtained using the quadrat method described in the materials and methods section. The mean values of weed dry weight obtained at different times are shown in (Table 1).

Table 1

The dry weight of weeds encountered in the plots

Treatment	Mean Dry Weight of Weeds (g)			
	2 WAS	4 WAS	6 WAS	8 WAS
W0V1	0.78 ± 0.40	6.06 ± 5.10	67.7 ± 22.50	47.34 ± 30.70
W1V1	1.11 ± 0.04	3.80 ± 1.69	8.59 ± 12.83	3.59 ± 3.07
W2V1	2.36 ± 0.07	4.80 ± 5.87	29.48 ± 14.30	2.98 ± 2.66
W3V1	0.96 ± 0.64	3.14 ± 0.65	13.92 ± 8.53	8.98 ± 4.91
W0V2	0.85 ± 0.23	9.03 ± 2.71	56.78 ± 11.58	37.07 ± 31.61
W1V2	1.81 ± 1.17	6.64 ± 1.22	16.68 ± 23.94	9.73 ± 8.84
W2V2	1.18 ± 1.17	1.98 ± 1.39	28.40 ± 7.20	0.73 ± 0.81
W3V2	1.28 ± 0.52	4.06 ± 2.99	32.35 ± 18.46	8.97 ± 5.47

The growth pattern of weeds based on dry weight showed that there was no significant difference among all the plots at 2 and at 4 WAS. Six weeks after sowing however, there was drastic increase in the dry matter of the weeds. The weed growth rate was faster between 4-6 WAS compared to the growth rate between 6-8 WAS (Table 1). As expected, the results showed that weed level at 6 weeks was higher than at 4 weeks which in turn was higher than at 2 WAS; there was a drop in weed level at 8 WAS compared to 6 WAS. The unwedded plots had significantly the highest level of weed biomass compared to weeded plots.

CONCLUSIONS

The results of this study therefore suggest that farmers should be encouraged to weed their soybean field 2 weeks after sowing, followed by a second weeding at 6 weeks after sowing for an optimum yield in soybean crop. This weeding sequence (2 and 6 WAS) supports proper weed control as a management practice so that apart from keeping soybean absolutely free of the adverse effect of weeds , it also ensures a favourable cost-benefit ratio in respect to weeding control in soybean cultivation in south- western Nigeria.

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REZUMAT

PERFORMANȚE LA SOIA (*GLYCINE MAX* (L.) MERRILL) SUB INFLUENȚA GRADULUI DE ÎMBURUIENARE, ÎN SUD-VESTUL NIGERIEI

În două câmpuri experimentale ale Fermei Didactice şi de Cercetare, din Universitatea din Ibadan, Nigeria, în anii 1999 şi 2001, au fost studiate performanţele a două cultivaruri de soia în condiţii variate de îmburuienare: a) fără buruieni, cu buruieni după diferite intervale de timp (săptămâni) de la semănat: b) la 2 şi la 4 săptămâni; c) la 2 şi la 6 săptămâni; d) la 2 şi la 8 săptămâni. Experienţa a fost organizată după metoda blocurilor complete randomizate, cu un număr de patru repetiţii pe variantă reprezentată de combinaţia soi x grad de îmburuienare. Au fost efectuate analize la maturitatea de vegetaţie a plantelor, referitoare la conţinutul în substanţă uscată şi parametrii de producţie. Buruienile competitoare au fost identificate, grupate în eşantioane, uscate şi cântărite. Datele au fost prelucrate prin testul ANOVA, stabilindu-se valorile LSD (P=0.05). Rezultatele au arătat că buruienile nu au afectat performanţele celor două soiuri de soia la 2 săptămâni de la semănat. La recoltare, s-a constatat că două specii de buruieni nu au influenţat producţia de soia, dar intervalul de îmburuienare a fost important pentru producţia obţinută. Buruienile au exercitat o concurenţă negativă asupra plantelor şi producţiei de soia la 4 şi la 6 săptămâni de la semănat. Rezultatele au demonstrat că, în mod inevitabil, îmburuienarea a determinat o scădere de producţie la ambele soiuri. Îmburuienarea produsă între 2 şi 6 săptămâni de la semănat a avut consecinţe mai puţin severe asupra producţiei celor două soiuri de soia decât alte intervale de îmburuienare. Îmburuienarea între 2 şi 6 săptămâni de la semănat nu a afectat perioada vegetativă sau cea reproductivă a plantelor, în acest caz recolta fiind apropiată de optimul de producţie înregistrat în varianta fără buruieni.