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RESPONSE OF WEEDING REGIMES AND PLANTING LOCATION ON THE GROWTH AND YIELD OF SOYBEAN

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Abstract:

Soybean (*Glycine max* (L.) is an important staple and industrial crop grown in tropical, subtropical and temperate regions of the world. However, its production is constrained by incessant weed competition for nutrient, water and sunlight which reduces output. To minimize the impact of weed competition, this study assessed the effectiveness of different weed management regimes. Soybean seeds were sown in two (2) locations of Delta State (Asaba and Ozoro), and the weed management regimes were T1: No weeding, T2: weeding 3 weeks after planting, T3: weeding 3, 6 weeks after planting, T4: weeding, 3, 6, 9 weeks after planting, and T5: weeding all through. The experiment was a 2 (location) by 5 (weeding regimes) factorial arranged in a randomized complete block design (RCBD) and replicated three times. Data were collected on the agronomic and number of pods produced. Data collected were analysed using analysis of variance and means were separated using least significant differences. At 12 weeks after planting, the plant height, number of leaves and number of pods produced differed significantly and ranged from 24.33±1.02 (Asaba) to 41.46±1.02 (Ozoro), 21.47±1.69 (Asaba) to 48.10±1.69 (Ozoro), and 15.25±1.39 (Asaba) to 24.44±1.39 (Ozoro) between locations, and ranged from 31.90±1.90 (T2) to 37.97±1.90 (T5), 23.93±3.18 (T1) to 41.63±3.18 (T5), and 12.78±2.62 (T1) to 25.01±2.62 (T5) amongst the treatments. Keeping the soybean farm weed-free ensures higher productivity relative to less weeded plots.

Keywords:

Weed-free; Soybean; Farm management; Productivity; Location.

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INTRODUCTION

Soybean belongs to the family Fabaceae (Leguminosae). The Synonyms of the crop *are Dilichossoja L., Glycine anguistifoiliamiq, Glycine gracillisskerstove, Glycine hispida (Moench) Maxim, Glcinehispida var., Glycine soja (L.) Merr, Glycine ussurensisRegeal and Maack, etc* (Schmutz*et al.,* 2010). Fasusi et al. (2022) noted that Soyabean can be grown throughout the year in the tropics and subtropics if water from rainfall or other sources is available. He noted that the crop requires 400-500mm of water for a good crop yield. Specifically, high moisture contents is critical at the time of germination, flowering and pod formation stage. IFAD (2019) elucidated that Soybean can be grown on a wide range of altitudes ranging from 600m in the valley to 1500m on the plateau and highland as long as adequate soil moisture is available during the period of growth.

Fussy and Papenbrock (2022) opined that knowledge of naturally suitable locations for the cultivation of a particular soil type is a basis for effective natural resource management and sustainable agriculture. They also stated what should be avoided for selection of site for Soybean production to include; (a) land on steep slope (b) land near swamp or waterlogged areas (c) areas with lots of couch grass and (d) areas with lots of shade. Briceno*et al.* (2021) selected highly suitable sites with the use of weather station networks. They also stipulated that land should be properly cleared of all vegetation to enhance good contact between seed and soil to guarantee rapid germination and reduce weed infestation. In this regard, it noted that ploughingshould be done using hoe or plough to turn top soil and incorporate plant residue into the soil. It specifically noted that land preparation should be done two weeks before planting, with inbounds or ridges used to ensure good drainage and deep cultivation should be done to improve oxygen supply and digging diversion water ways should be done along the contours to minimize soil waterwash. In the assertion of Omoigui*et al.* (2020), all vegetation should be cleared before land preparation with the seed bed prepared manually with hoe or animal drawn implement or tractor.

Weed infestation is a major cause of poor yield in soybean production requiring proper management resulting in one of the most expensive steps in its production (Storkey*et al*., 2021). Song*et al*. (2021) stipulated that the presence of weeds causes a shortage of up to 40% of the crop. Tehile*et al.* (2021) noted that losses dues to weeds is one of the most limiting factors in Soybean production necessitating weed control as one of the most important practices for economical Soybean production. Keramatic*et. al.,* (2008) outlined the critical period of weed control in soybean as between the stages of V2 (26 days after planting) to R1 (63 days after planting). They highlighted that weed control should be embarked upon during this period to provide maximum grain yield.

Omoigui et al. (2020)from another perspective noted that perennial and most annual weeds can hamper growth in the early stages of Soybean growth. They asserted that a properly timed weed control program can minimize their effects. They further elucidated that weed control in Soybean could be achieved manually or with the use of chemicals or by a combination of both methods. They noted that the manual weed control which is carried out by hoe weeding is done first at 2 weeks after planting and second at 5-6 weeks after planting.

They noted that weeding should be avoided immediately after the rains as this could lead to transplanting the weeds. Furthermore, poor hoe weeding or delay in weeding may cause a significant reduction in Soybean yields. The chemical weed control which involves the use of herbicide was noted to be a choice based on the predominant weed species and the availability of the herbicide. The integrated weed control method that noted which involves the application of pre-emergence herbicide before planting may allow for only one more weeding at 5-6 weeks after planting (Song et al., 2021).

However, the residual effect of herbicides in the environment and in some instances the effect on the unintended plant (soybean) leaves the farmer with the option of optimizing the appropriate manual weeding conditions for improved production in a subsistence farming system. This study therefore assesses the impact of different weeding regimes in the productivity of soybean in two locations of Delta State, Nigeria.

MATERIALS AND METHODS

Experimental site: The experiment was conducted in two locations; 1. Teaching and Research Farm of the Department of Crop science of the Faculty of Agriculture in the Dennis Osadebay University, Asaba, located at Latitude 05° 32'N to 06° 10'N and Longitude 06° 49'E to 13° 12'E. 2. Teaching and Research Farm of Department of crop science, Faculty of Agriculture, Delta state university of science and technology, Ozoro, located at latitude 06° 15’N and longitude 07°10’E.

Land preparation and tillage: The land was cleared of all vegetation and debris, packed and burnt. The land was subsequently tilled to a depth of 10 cm using hoe.

Sowing: The soybean seeds were sown in plots at a rate of one seed per hole at a depth of 2cm by dibble method using a recommended standard spacing of 10 x 75cm.

Plot layout: Each plot measured 3m x 3m and contained one hundred and fifty seedlings. Each plot was separated from another by 0.5m pathway, while the replicates were separated by lm pathway to allow for proper management.

Weeding: Weeding was done manually using hand held hoe. The weeding pattern followed the designated weeding regime of T1: No weeding, T2: weeding 3 weeks after planting, T3: weeding 3, 6 weeks after planting, T4: weeding, 3, 6, 9 weeks after planting, and T5: weeding all through.

Experimental design: The experiment was laid in a 2 (location) by 5 (weeding regimes) factorial arranged in a randomized complete block design and replicated three times.

Sampling of experimental units: Within each plot, five soybean seedlings were selected from the net plot and tagged for sampling. From these units appropriate data specified were collected over defined periods.

Data collectionand statistical analysis: Data were collected on the plant emergence, plant height, number of leaves, leaf area, number of branches, internode length at 2, 4, 6, 8, 10, and 12 weeks after planting, while the number of pods produced were recorded at 8, 10 and 12 weeks after planting. Data collected were subjected analysis of variance, and differences in treatment means were separated using the least significant differences at 5% level of significance.

RESULTS

Table 1 showed that there were no significant differences between location, weeding regimes and the interaction between weeding regimes and locations of planting with respect to the plants emergence.

Table 2 showed that the plant height increased gradually from 2 WAS to 12 WAS across the locations and seed weeding regimes. At 12 WAS the plants grown in Ozoro (41.46±1.02) was significantly taller than Asaba (24.33±1.02). Also at the 12WAS, T5 (37.97±1.90) was significantly taller than T1 (32.20±1.90) and T2 (31.90±1.90).

Table 3 showed that the number of leaves produced increased gradually from 2 WAS to 12 WAS across the locations and weeding regimes. At 12 WAS the plants grown in Ozoro (48.10±1.69) was significantly taller than Asaba (21.47±1.69). Also at the 12WAS, T5 (41.63±3.18) was significantly taller than T1 (23.93±3.18).

Table 4 showed that the plants leave area increased gradually from 2 WAS to 12 WAS across the locations and weeding regimes. At 8 WAS the leaf area of the plants grown in Ozoro (24.14±1.22) was significantly larger than Asaba (20.07±1.22). However, at the 12WAS, T5 (29.97±2.07) was significantly larger than T1 (20.30±2.07) and T2 (23.40±2.07).

Table 5 showed that the number of branches produced increased gradually from 2 WAS to 12 WAS across the locations and weeding regimes. At 12 WAS, branches produced by the plants grown in Asaba (10.52±0.31) was significantly higher than Ozoro (6.96±0.31). Also at the 12WAS, the branches produced by T5 (9.58±0.57) was significantly higher than T1 (7.68±0.57).

Table 6 showed that the internode length increased gradually from 2 WAS to 12 WAS across the locations and weeding regimes. At 12 WAS, the internode length of the plants grown in Ozoro (31.81±1.04) was significantly longer than Asaba (22.80±1.04). However, at the 12 WAS, T5 (32.13±1.94) was significantly longer than T1 (24.16±1.94) and T2 (25.24±1.94).

Table 7 showed that the number of pod production increased gradually from 8 WAS to 12 WAS across the locations and weeding regimes. At 12 WAS the number of pods produced by plants grown in Ozoro (24.44±1.39) was significantly higher than Asaba (15.25±1.39), while T5 (25.01±2.62) was significantly higher than T1 (12.78±2.62) and T2 (18.28±2.62).

Table 1. Effect of weeding regimes and planting locations on the emergence of soybean seeds

Location	Emergency
Asaba	54.83a
Ozoro	54.21a
LSD(0.05)	6.13
SE	2.12
Trt*Loc	108.01ns
Treatments	
T1	57.78a
T2	49.11a
T3	54.28a
T4	57.83a
T5	58.72a
LSD(0.05)	11.47
SE	3.96

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences. SE: Standard error. T1 No weeding, T2 weeding 3 weeks after planting, T3 weeding 3, 6 weeks after planting, T4 weeding, 3, 6, 9 weeks after planting, T5 weeding all through.

Table 2. Effect of weeding regimes and planting locations on the height of soybean plants

Location	PH2	PH4	PH6	PH8	PH10	PH12
Asaba	7.20b	13.57b	16.33b	19.33b	22.11b	24.33b
Ozoro	14.05a	21.63a	34.65a	41.44a	41.29a	41.46a
LSD(0.05)	0.91	1.29	2.44	3.03	3.49	2.94
SE	0.31	0.45	0.84	1.05	1.21	1.02
Trt*Loc	3.53ns	2.71ns	16.55ns	22.91ns	30.59ns	43.15ns
Treatments						
T1	10.93a	16.84ab	23.22b	27.42b	28.90b	32.20b
T2	10.62a	17.65ab	25.50ab	29.40ab	30.80ab	31.90b
T3	10.40a	18.05ab	27.13ab	31.67ab	32.42ab	34.97ab
T4	10.77a	17.71ab	23.70b	29.83ab	31.53ab	32.73ab
T5	11.14a	19.15a	28.53a	34.41a	36.43a	37.97a
LSD(0.05)	1.69	2.43	4.57	5.67	6.54	5.51
SE	0.59	0.84	1.58	1.96	2.26	1.9

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences. SE: Standard error. Trt*Loc: Interaction between treatments and location. T1 No weeding, T2 weeding 3 weeks after planting, T3 weeding 3, 6 weeks after planting, T4 weeding, 3, 6, 9 weeks after planting, T5 weeding all through. PH2-PH8: Plant height at 2 WAS to Plant height at 8 WAS.

Table 3. Effect of weeding regimes and planting locations on the number of leaves produced by soybean plants

Location	NOL2	NOL4	NOL6	NOL8	NOL10	NOL12
Asaba	2.46b	6.07b	9.29b	16.78b	19.57b	21.47b
Ozoro	8.97a	16.13a	31.22a	46.87a	49.59a	48.10a
LSD(0.05)	0.55	1.15	3.29	4.26	5.11	4.92
SE	0.19	0.39	1.14	1.47	1.76	1.69
Trt*Loc	0.55ns	5.29ns	27.14ns	73.70ns	150.99ns	138.83ns
Treatments						
T1	5.53a	9.99b	15.50b	22.63b	21.83b	23.93c
T2	5.60a	10.70ab	20.10ab	33.23a	35.47a	34.63ab
T3	5.13a	11.60ab	22.10a	34.00a	38.13a	37.97ab
T4	5.52a	11.27ab	21.20ab	33.83a	36.67a	37.27ab
T5	6.00a	12.23a	22.43a	37.10a	40.87a	41.63a
LSD(0.05)	1.02	2.16	6.16	7.97	9.56	9.21
SE	0.35	0.74	2.13	2.75	3.29	3.18

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences. SE: Standard error. Trt*Loc: Interaction between treatments and location. T1 No weeding, T2 weeding 3 weeks after planting, T3 weeding 3, 6 weeks after planting, T4 weeding, 3, 6, 9 weeks after planting, T5 weeding all through. T1 No weeding, T2 weeding 3 weeks after planting, T3 weeding 3, 6 weeks after planting, T4 weeding, 3, 6, 9 weeks after planting, T5 weeding all through.

Table 4. Effect of weeding regimes and planting locations on the leaf area of soybean plants

Location	LA2	LA4	LA6	LA8	LA10	LA12
Asaba	10.52a	13.52a	18.38b	20.07b	23.21a	26.49a
Ozoro	7.39b	15.27a	24.75a	24.14a	23.61a	24.21a
LSD(0.05)	0.87	2.12	3.64	3.55	3.12	3.21
SE	0.29	0.73	1.26	1.22	1.08	1.11
Trt*Loc	1.62ns	7.57ns	30.56ns	16.64ns	31.15ns	55.36ns
Treatments						
T1	7.85b	12.97a	17.07a	15.72c	16.05c	20.30c
T2	8.76ab	12.70b	19.76a	22.65ab	22.92ab	23.40bc
T3	9.14ab	15.31b	23.33a	22.68ab	24.19ab	26.37ab
T4	9.44ab	14.68a	23.49a	24.70ab	27.84a	29.25ab
T5	9.70a	15.40a	23.51a	25.72a	25.80ab	29.97a

LSD(0.05)	1.63	3.97	6.82	6.63	5.83	6.01
SE	0.56	1.37	2.35	2.29	2.01	2.07

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences. SE: Standard error. Trt*Loc: Interaction between treatments and location. T1 No weeding, T2 weeding 3 weeks after planting, T3 weeding 3, 6 weeks after planting, T4 weeding, 3, 6, 9 weeks after planting, T5 weeding all through.

Table 5. Effect of weeding regimes and planting locations on the number of branches of soybean plants

Location	NOB2	NOB4	NOB6	NOB8	NOB10	NOB12
Asaba	1.00a	2.00a	5.20a	7.14a	8.55a	10.52a
Ozoro	1.00a	2.00a	5.87a	6.72a	7.10b	6.96b
LSD(0.05)	0	0	0.74	0.87	0.83	0.89
SE	0	0	0.25	0.29	0.29	0.31
Trt*Loc	0.00ns	0.00ns	1.24ns	1.13ns	2.04ns	3.39ns
Treatments						
T1	1.00a	2.00a	4.45b	5.52c	6.32b	7.68b
T2	1.00a	2.00a	5.52ab	7.15ab	7.77ab	8.92ab
T3	1.00a	2.00a	5.78ab	6.27bc	8.00a	8.82ab
T4	1.00a	2.00a	5.57ab	7.12abc	8.08a	8.72ab
T5	1.00a	2.00a	5.88	7.42ab	8.07a	9.58a
LSD(0.05)	0	0	1.38	1.62	1.55	1.66
SE	0	0	0.48	0.56	0.53	0.57

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences. SE: Standard error. Trt*Loc: Interaction between treatments and location. T1 No weeding, T2 weeding 3 weeks after planting, T3 weeding 3, 6 weeks after planting, T4 weeding, 3, 6, 9 weeks after planting, T5 weeding all through.

Table 6. Effect of weeding regimes and planting locations on the internode length of soybean plants

Location	IL2	IL4	IL6	IL8	IL10	IL12
Asaba	4.73b	9.86b	13.10b	15.53b	20.01b	22.80b
Ozoro	9.82a	13.48a	25.52a	28.55a	29.10a	31.81a
LSD(0.05)	0.51	1.03	2.06	2.73	3.09	3
SE	0.18	0.36	0.71	0.94	1.07	1.04
Trt*Loc	1.26ns	3.27ns	24.37ns	34.45ns	29.12ns	28.63ns
Treatments						
T1	7.42ab	11.64a	15.83b	18.14c	19.74b	24.16b

T2	6.29c	11.56a	18.99ab	22.30abc	23.43ab	25.24b
T3	7.18bc	12.01a	21.20a	21.53abc	26.23a	29.68ab
T4	7.23bc	11.51a	18.73ab	20.36bc	25.45ab	28.49ab
T5	8.28a	12.05a	21.22a	26.27a	29.22a	32.13a
LSD(0.05)	0.95	1.93	3.86	5.11	5.79	5.62
SE	0.33	0.67	1.33	1.76	2	1.94

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences. SE: Standard error. Trt*Loc: Interaction between treatments and location. T1 No weeding, T2 weeding 3 weeks after planting, T3 weeding 3, 6 weeks after planting, T4 weeding, 3, 6, 9 weeks after planting, T5 weeding all through.

Table 7. Effect of weeding regimes and planting locations on the number of branches of soybean plants

Location	NoPod8	NoPod10	NoPod12
Asaba	6.38a	9.60b	15.25b
Ozoro	6.43a	21.66a	24.44a
LSD(0.05)	1.76	4.23	4.06
SE	0.61	1.46	1.39
Trt*Loc	0.73ns	86.32ns	69.36ns
Treatments			
T1	4.65c	7.97c	12.78c
T2	5.55c	15.17abc	18.28bc
T3	8.90ab	20.20a	22.49ab
T4	5.33c	15.52abc	23.17ab
T5	9.20a	21.14a	25.01a
LSD(0.05)	3.29	7.91	7.59
SE	1.14	2.73	2.62

Means with the same alphabet down the groups are not significantly different from each other at 5% level of significance. LSD: Least significant differences. SE: Standard error. Trt*Loc: Interaction between treatments and location. T1 No weeding, T2 weeding 3 weeks after planting, T3 weeding 3, 6 weeks after planting, T4 weeding, 3, 6, 9 weeks after planting, T5 weeding all through.

DISCUSSION

Soybean is a valuable crop worldwide due to its direct use as food, and in the industries (Gai et al., 2025). However, the low production challenge creates an opportunity for produces to tap into its value chain by improving the agronomic processes and deliberate choice of cultivation area that supports higher output (Obidiebube et al., 2013). To enhance productivity, one of the major militating factor to address is the occurrence of weed which creates a direct competition with the plants for food, water and sunlight (Bianchi et al., 2021).

It is important to keep every farm weed free to avoid the weeds competing with the plants for nutrients, space, and sunlight, thereby reducing the growth and yield of the plants. However, this does not imply that no single weed will be sighted in the farm, but before they grow to a point of obvious competition with the plants, they needed to be weeded. In this research, the frequent weeding of 3, 6, and 9 weeks after planting gave similar yield as the weedy-free treatments, unlike the less frequently weeded plots (Tehulie et al., 2020). This is an important finding as it has a direct implication of reducing the cost of production for the farmers.

The seed weight, protein and oil content of soybean seeds has been described as a major soybean coordinating factors that are controlled or regulated by both genetic and environmental factors (Lu et al., 2021; Bianchi et al., 2021; Gottel et al., 2022; Duan et al., 2023). Hence, the interaction between the plants and the surrounding environment is critical in the management of a soybean farm (Gaut et al., 2018). Good agronomic practices (GAP) employed in the cultivation of every crop directly results in a higher / optimum harvest, and one of the frequently advocated component of GAP in soybean production is the recommendation of keeping the farm weed free (Toomer et al., 2023). In this study, plots that hand weeding of the soybean farm at 3, 6, and 9 weeks after sowing were carried out had the highest percentage of plant emergence relative to less weeding frequencies.

This could be as a result of less competition between the seeds and the surrounding weeds for nutrient as the early season weed competition is very critical for the establishment of soybean plants (Tehulie et al., 2020). The frequent weeding is highly important as if left unweeded, the weeds might grow so tall that during the actual weeding period, the soybean plants might be mistakenly weeded along the weeds which will reduce the plants establishment rate per plot and a loss of up to 40% has been reported due to weed competition (Tehulie et al., 2020). The findings of this study also showed that the growth and yield parameters of the soybean plants increased as the frequency of weeding increases in the following order; hand weeding 3 WAS <hand weeding 3 and 6 WAS < hand weeding 3, 6, and 9 WAS, respectively.

The more frequently weeded plots also produced plants with better growth rate relative to less weeding frequencies. This is because as the plant continues to grow, it will need to continue feeding on the available nutrient from the soil, and less competition from the neighboring weeds means the available soil nutrient serves only the purpose of supplying nutrients to the plants through the rooting systems, and this allows for optimum nutrient assimilation. However, in situations where the plots are surrounded by weeds for an extended period of time, the weeds and the soybean plants competes for the available nutrient in the soil for growth and development (Tehulie et al., 2020. However, one of the major characteristics of weeds is the ability to adapt better than domesticated plants (Neve and Caicedo, 2022).

The weeds achieve this through several mechanisms such as the releases of allelopathic substances to the environment which are usually harmful to a competing plant (Khamare et al., 2022). Another major disadvantage of allowing the weeds to compete with the soybean plants is the problem of space competition whereby the weeds may sometimes outgrow the plants and thereby limiting the plants access to adequate amount of sunlight for photosynthetic purposes (Korav et al., 2018). This causes a situation known as etiolation in the soybean plants where the plants will be bending towards the little space in search of sunlight. This situation leads to the poor growth and fruit development rate, and consequently poor plant yield as the soybean plant could not have adequate amount of energy to manufacture its own food and channel them to different parts like the flowers for seed formation (Zhang et al., 2016).

Also, the disparity in the yield obtained between the two locations could be attributed to the fact that weed occurrence was more frequent in Asaba relative to Ozoro, hence increasing the competition between the plants grown in the two areas which resulted in improved output in Ozoro (Korav et al., 2018).

CONCLUSION

Control of the weeds in the soybean farm is important, and the frequency of weeding was optimized in this study by the adoption of weeding the plots at 3, 6 and 9 weeks after planting which performed considerably equally with the weed-free regime. It is important to note the approximately equal yield in the 3, 6, and 9 weeks after planting weeding and the total weed-free practice as the later helps the farmer to save some cost of production while achieving same output. This weeding regime helped circumvent the inter competition existing between the weeds and the soybean plants for space, water, nutrient and sunlight which is needed for the plants manufacturing of its own food and development. Also, Ozoro location supported higher yield relative to Asaba.

REFERENCES

2020. Guide to Soybean Production in Northern Nigeria. Inter-
2020. Guide to Soybean Production in Northern Nigeria. Inter-
2021. Modeling the effects of nitrogen fertilizer and multiple

Bianchi F, Stewart C, Astbury NM, Cook B, Aveyard P, Jebb SA. Replacing meat with alternative plant-based products (RE-MAP): a randomized controlled trial of a multicomponent behavioral intervention to reduce meat consumption. Am J ClinNutr. (2021). 32:2416–2425.doi: 10.1093/ajcn/nqab414.

Briceno, R., Lopez, S.R., Lopez, S.O., Oliva-cruz, M., Fernandez, G.D., Murga, T.E., Trigoso, I.D., Gurbillion, B.M &Barboza, E. (2021). Site selection for a network of weather stations using AHP and near analysis in a GIS environment in Amazona, NW Peru. *Climate* 9 (12): 169

Chaudhary, Juhi& S M, Shivaraj& Khatri, Praveen & Ye, Heng& Zhou, Lijuan&Usovsky, Mariola & Dhakate, Priyanka & Kumawat, Giriraj & Patil, Gunvant & Sonah, Humira & Ratnaparkhe, Milind & Deshmukh, Rupesh & Nguyen, Henry. (2019). Approaches, Applicability, and Challenges for Development of Climate-Smart Soybean. 10.1007/978-3-319-93536-2_1.

Duan Z, Li Q, Wang H, He X, Zhang M (2023) Genetic regulatory networks of soybean seed size, oil and protein contents. Front Plant Sci 14:1160418

Ekeleme, F., Kumar, P.L., Ademulegun, T., Solomon, R.
Ekeleme, F., Kumar, P.L., Ademulegun, T., Solomon, R.

Fasusi, Samuel & Kim, Ji-Min & Kang, Sungtaeg. (2022). Current Status of Soybean Production in Nigeria: Constraint and Prospect. Journal of the Korean Society of International Agriculture. 34. 149-156. 10.12719/KSIA.2022.34.2.149.

Fussy, Andre &Papenbrock, Jutta. (2022). An Overview of Soil and Soilless Cultivation Techniques—Chances, Challenges and the Neglected Question of Sustainability. Plants. 11. 1153. 10.3390/plants11091153.

Gai, Yuhong& Liu, Shuhao& Zhang, Zhidan& Wei, Jian& Wang, Hongtao& Liu, Lu &Bai, Qianyue& Qin, Qiushi& Zhao, Chungang& Zhang, Shuheng& Xiang, Nan & Zhang, Xiao. (2025). Integrative Approaches to Soybean Resilience, Productivity, and Utility: A Review of Genomics, Computational Modeling, and Economic Viability. Plants. 14. 671. 10.3390/plants14050671.

Gaut BS, Seymour DK, Liu Q, Zhou Y (2018) Demography and its effects on genomic variation in crop domestication. Nat Plants 4:512–520

Goettel W, Zhang H, Li Y, Qiao Z, Jiang H, Hou D, Song Q, Pantalone VR, Song BH, Yu D et al (2022) POWR1 is a domestication gene pleiotropically regulating seed quality and yield in soybean. Nat Commun 13:3051

Horn, Lydia &Shimelis, Hussein. (2020). Production constraints and breeding approaches for cowpea improvement for drought prone agro-ecologies in Sub-Saharan Africa. Annals of Agricultural Sciences. 65. 10.1016/j.aoas.2020.03.002.

IFAD (2019). Soybean production manual. Enhanced small holders Agri-business promotion programme for field Extension Facilitators . Ministry of Agriculture, Republic of Zarrbia, P.1

Khamare, Yuvraj& Chen, Jianjun& Marble, Stephen. (2022). Allelopathy and its application as a weed management tool: A review. Frontiers in Plant Science. 13. 10.3389/fpls.2022.1034649.

Korav, Santosh & Dhaka, Anil & Singh, Ram & Reddy, G.. (2018). A study on crop weed competition in field crops. 7. 3235-3240.

Lu L, Wei W, Li QT, Bian XH, Lu X, Hu Y, Cheng T, Wang ZY, Jin M, Tao JJ et al (2021a) A transcriptional regulatory module controls lipid accumulation in soybean. New Phytol 231:661–678

national Institute of Tropical Agriculture, Ibadan, Nigeria. p.4

national Institute of Tropical Agriculture, Ibadan, Nigeria. p.4

Neve, Paul &Caicedo, Ana. (2022). Weed Adaptation as a Driving Force for Weed Persistence in Agroecosystems. 10.1002/9781119525622.ch15.

Obidiebube, Eucharia&Akparobi, Achebe. (2013). EVALUATION OF SOYBEAN VARIETIES (GLYCINE MAX L MERIL), FOR ADAPTATION TO TWO LOCATIONS OF RAINFOREST ZONE OF DELTA STATE. European Journal of Business and Innovation Research Vol.1, No.3, pp, 69 -73

Omoigui, L. O., Kamara, A. Y., Kamai, N., Dugje, I. Y., Ekeleme, E., Kumar, P. L., Ademulegun, T., Solomon, R. (2020). Guide to soybean production in Northern Nigeria. International Institute of Tropical Agriculture, Ibadan, Nigeria. P.4.

Omoigui, L.O., Kamara, A.Y., Kamai, N., Dugje, I.Y.,

Omoigui, L.O., Kamara, A.Y., Kamai, N., Dugje, I.Y.,

Omoigui, L.O., Kamara, A.Y., Kamai, N., Dugje, I.Y., Ekeleme, F., Kumar, P.L. and & Solomon, R. (**2020**). Guide to **soybean** production in northern Nigeria. Ibadan, Nigeria: IITA, (31 p.).

Schmutz, Jeremy & Cannon, Steven &Schlueter, Jessica & Ma, Jianxin&Mitros, Therese & Nelson, William &Hyten, David & Song, Qijian& Cheng, Jianlin&Xu, Dong &Hellsten, Uffe& May, Gregory & Yu, Yeisoo& Sakurai, Tetsuya &Umezawa, Taishi& Bhattacharyya, Madan& Sandhu, Devinder&Valliyodan, Babu& Jackson, Scott. (2010). Genome sequence of the paleopolyploid soybean. Nature. 463. 178-83. 10.1038/nature08670.

Song J, Im J, Kim J, Kim D , Lim Y, Yook M, Lim S and Kim D.

Song, J., Im, J., Kim, J., Kim, D., Lim, Y., Yook, M., Lim, S. and Kim, D. (2021). Modelling the effects of nitrogen fertilizer and multiple weed interference on soybean yield. Agronomy, 11:515.

Storkey, J., Addy, J., Mead, A., Macdonald, AJ.,(2021). Agricultural intensi□cation and climate change have increased the threat from weeds. Global Change Biology 27,

Tehulie, Nuru&Misgan, Tenalem& Awoke, Tigist. (2021). Review on weeds and weed controlling methods in soybean (Glycine max L.). International Journal of Current Research. 1-06.

Toomer, Ondulla& Oviedo, Edgar & Ali, Muhammad &Patino, Danny & Joseph, Michael &Frinsko, Michael & Vu, Thien&Maharjan, Pramir& Fallen, Ben &Mian, Rouf. (2023). Current Agronomic Practices, Harvest & Post-Harvest Processing of Soybeans (Glycine max)—A Review. Agronomy. 13. 427. 10.3390/agronomy13020427.

weed interference on soybean yield. Agronomy11: 515.

Zhang YL, Li CH, Wang YW, Hu YM, Christie P, Zhang JL, (2016). Maize yield and soil fertility with combined use of compost and inorganic fertilizers on a calcareous soil on the North China Plain. Soil & Tillage Research. 155: 85–94.