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PERFORMANCE OF SOYBEAN [*Glycine max* (l.) merr.] VARIETIES UNDER DIFFERENT LEVELS OF INOCULATION AND SOWING DATE IN THE GUINEA SAVANNA

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Abstract: In Africa, Nigeria is recognized as the leading and largest producer of soybean. However, an optimum yield of the crop had far not been obtained for stable and sustainable production to meet the increasing demand for human consumption and a source of feed for the poultry industry. A field trial was conducted during the 2018 rainy season at the research field of International Institute of Tropical Agriculture, University farm of Ahmadu Bello University, Zaria at Samaru, in the Northern Guinea Savanna, and International Institute of Tropical Agriculture research farm, Kubwa, Abuja in the Southern Guinea Savanna of Nigeria. The treatments consist of four varieties of soybean (TGx 1904-6F, TGx 1951-3F, TGx 1955-4F, and Sambaiba), two sowing dates (late June and early July), and two levels of inoculation (inoculation and without inoculation). The trial consists of 16 treatments which were factorially combined and laid out in a Randomized Complete Block Design (RCBD) in split plot arrangement, replicated three times. The results revealed that the rhizobia inoculated treatments had a significantly (P≤ 0.05) higher number of pods per plant (33.83), seed per plant (67.9), grain yield per hectare (2145kgha^{-1}), and heavier 100-seed weight (16.55 g). Number of pods per plant (36), number of seeds per plant (64), number of nodules per plant (52.93) and grain yield per hectare (2035.7kgha^{-1}) responded significantly (P≤ 0.05) to the sowing date. Late June sowing outperformed early July sowing in these parameters. The results further indicated that varieties TGx 1951-3F (2172.18kgha^{-1}) and Sambaiba (2240.3kgha^{-1}) out yielded the other varieties at Kubwa and Samaru respectively. Based on the results obtained from this study, it can be concluded that application of rhizobia inoculant, late June sowing date, use TGx 1951-3F and Sambaiba varieties produce the highest grain yield per hectare in the Guinea Savanna of Nigeria.

• Introduction

- Soybean (*Glycine max.*) is a leguminous crop that grows in a tropical, subtropical and temperate climate. The crop was introduced to Africa in the 19th century by Chinese traders along the East Coast of Africa [1]. Soybean range in composition of protein content is high, making it the richest source of plant protein [2] and requires less energy, moisture and land to provide the world with sufficient protein. [3]. The oil extracted from soybean is cheap, highly digestible and contains no cholesterol. The crop also improves soil fertility by having the potential of fixing atmospheric nitrogen into the soil and sometimes used as cover crop to prevent erosion [1]. This is a major benefit in African farming systems, where soils become exhausted due to continuous cropping to feed the increasing populations and where fertilizers are not available or are too expensive for farmers to buy (CGIAR, 2007).

• Material and method

- Field trials were conducted during 2018 rainy Season at the research field of International Institute of Tropical Agriculture, University farm of Ahmadu Bello University, Zaria at Samaru (11^{0}11'N, 07^{0}38'E, 686m above sea level), Northern Guinea Savanna and research farm of International Institute of Tropical Agriculture, Kubwa (09^{0}09'N, 07^{0}20'E, 447m above sea level), Abuja, Southern Guinea Savanna of Nigeria. The treatments consisted of four varieties of soybean (TGx 1904-6F, TGx 1951-3F, TGx 1955-4F and Sambaiba), two sowing dates (late June and early July), and two levels of inoculation (with inoculation and without inoculation). The treatments were laid out in a Randomized Complete Block Design (RCBD), and replicated three times. TGx 1904-6F, is a medium maturing variety, which matures in 104 - 114 days, with an attainable yield of 2.5-2.7 ha^{-1}. TGx 1951-3F is also a medium maturing variety, and matures in 105 - 110 days with an attainable yield of 1.7-2.4 ha^{-1}. TGx 1955-4F is a medium maturing variety, and matures in 105 - 110 days with an attainable yield of 1.4-2.6 ha^{-1} [10]. Sambaiba variety matures in 121 days, with an attainable yield of 2.4 ha^{-1}.

- Prior to sowing, soil samples were randomly collected using auger of 10 cm diameter at a depth of 0-30 cm across the experimental sites; the samples were bulked and a composite soil sample was analyzed for the physical and chemical properties, using standard procedure as described by Black [15]. The fields were harrowed twice to obtain a fine tilt, ridges were made at 75 cm spacing apart, and the fields were marked into plots and replications. The gross and net plot sizes were 15 and 7.5 m^2 respectively. A space of 0.5 m between the plots and 1.5 m between the replicates was maintained. Inoculation was done by measuring 10 kg of the seed and gum Arabic of (20 g) was dissolved in 200 mls warm water. The gum Arabic solution was allowed to settle down before use. The seeds were then moistened with the gum Arabic solution and mixed thoroughly. The inoculant (Nodumax) was sprinkled on the moistened seeds and also mixed thoroughly, ensuring that all the seeds were effectively covered with the inoculant. The moistened inoculated seeds were spread on a clean tarpaulin and kept away from direct sunlight for 7 minutes before sowing. Seeds were sown at 10 x 75 cm apart. Six seeds were sown per hole and later thinned to four plants per stand at 14 days after sowing. Sowing was done on the 25th of June, 2018 and 2nd of July, 2018 for Samaru location; and 27th of June, 2018 and 4th of July, 2018 for Kubwa. During planting, single super phosphate and muriate of potash fertilizers were broadcasted to supply P_2O_5 and K_2O at the rate of 40 kg each per hectare. The plots were treated with pre-emergence herbicide (Pendimenthalin) at the rate of 1.6 a.i kg ha^{-1} using a CP15 Knapsack sprayer, fitted with a green deflector nozzle, and set at a pressure of 2.1 kgm^{-2} to deliver 280 L ha^{-1} of spray liquid. Hoe weeding was done at 4 weeks after sowing (WAS). Data was taken on number of pods per plant, number of seeds per pod, number of seeds per plant, number of nodules per plant, 100-seed weight and harvest index. All the data collected was subjected to analysis of variance using SAS software [16]. Treatment means were compared using Duncan Multiple Range Test [17].

• Results and discussions

Table 1: Influence of Inoculation, Sowing Date and Soybean Varieties on number of po and number of seeds per plant in 2018 Rainy Season at Kubwa and Samaru

Treatment	Number of Pods per plant		Number of seeds per pod	
	Kubwa	Samaru	Kubwa	Samaru
Inoculation (I)				
Inoculated	33.83a	40.34	2.09	1.36
Non-inoculated	24.88b	40.84	2.16	1.24
SE±	1.099	2.069	0.061	0.050
Sowing date(S)				
Late June	31.06a	42.82	2.17	1.28
Early July	27.65b	38.36	2.08	1.32
SE±	1.099	2.069	0.061	0.050
Variety (V)				
Sambaiba	24.04c	49.50a	3.03a	1.59a
TGx 1904-6F	34.36a	42.99ab	1.55c	1.10c
TGx 1951-3F	30.98ab	39.12bc	1.68c	1.15c
TGx 1955-4F	28.04bc	30.76c	2.25b	1.36b
SE±	1.554	2.926	0.086	0.071
Interaction				
S x I	NS	NS	NS	NS
V x I	NS	NS	NS	NS
V x S	NS	NS	NS	NS
V x S x I	NS	NS	NS	NS

Means followed by the same letter (s) within a treatment group in a column are statistically similar at 5% level sowing. NS= Not significant and SE± = Standard Error

Table 2: Influence of Inoculation, Sowing Date and Soybean Varieties on number of nodules per plant, 100-seed weight and harvest index in 2018 Rainy Season at Kubwa and Samaru

Treatment	No of nodules per plant		100- seed weight		Harvest Index	
	Kubwa	Samaru	Kubwa	Samaru	Kubwa	Samaru
Inoculation (I)						
Inoculated	29.00	50.49	14.06	16.55a	0.37	0.28
Non-inoculated	28.07	36.22	13.86	15.59b	0.36	0.27
SE±	3.265	4.956	0.231	0.310	0.007	0.010
Sowing date(S)						
Late June	28.48	52.93a	14.28	15.96	0.37	0.27
Early July	28.59	33.78b	13.65	16.18	0.36	0.28
SE±	3.265	4.956	0.231	0.310	0.007	0.010
Variety (V)						
Sambaiba	22.73	44.13	13.75	15.79bc	0.31c	0.32a
TGx 1904-6F	30.27	40.21	14.53	14.72c	0.37b	0.24b
TGx 1951-3F	29.79	47.81	13.98	16.51ab	0.43a	0.27b
TGx 1955-4F	31.35	41.27	13.60	17.27a	0.35b	0.27b
SE±	4.617	7.009	0.327	0.438	0.010	0.014
Interaction						
S x I	NS	NS	NS	NS	NS	NS
V x I	NS	NS	NS	NS	NS	NS
V x S	NS	NS	NS	NS	NS	NS
V x S x I	NS	NS	NS	NS	NS	NS

[Table 3: Influence of Inoculation, Sowing Date and Soybean Varieties on Grain Yield (Kg ha^{-1}) in 2018 Rainy Season at Kubwa and Samaru.

Treatment	Kubwa	Samaru
Inoculation (I)		
Inoculated	2145.51a	2063.68a
Non-inoculated	1789.93b	1869.18b
SE±	42.502	33.583
Sowing date (S)		
Late June	2022.78	2035.74a
Early July	1912.65	1897.11b
SE±	42.502	33.583
Variety (V)		
Sambaiba	1607.90b	2240.34a
TGx 1904-6F	2005.71a	1787.73c
TGx 1951-3F	2172.18a	2034.24b
TGx 1955-4F	2085.08a	1803.39c
SE±	60.107	47.493
Interaction		
S x I	NS	NS
V x I	NS	*
V x S	NS	NS
V x S x I	NS	NS

Means followed by the same letter (s) within a treatment group in a column are statistically similar at 5% level of probability using DMRT. NS= Not significant, SE± = Standard Error and *= Significant.

Table 4 : Interactions between Variety and Inoculation on Grain yield (Kg ha^{-1}) at Samaru.

	Inoculation	
Variety	With	without
Sambaiba	2385.63a	2095.05b
TGx 1904-6F	1800.18cd	1775.28d
TGx 1951-3F	2089.05b	1979.43bc
TGx 1955-4F	1979.85bc	1626.93d
SE±	67.165	

Means followed by the same letter (s) within a treatment group in a column or row are statistically similar at 5% levelf probability using DMRT.

• Conclusions

- The research evaluated the performance of [*Glycine max* (L.) Merr.] varieties to inoculation and sowing date in Guinea Savanna, Nigeria. From the results of this study, it was concluded that application of inoculant in late June sowing date and the use of TGx 1951-3F, and Sambaiba varieties produce the highest grain yield per hectare at Kubwa and Samaru respectively.