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Contents

# EFFECTS OF INTEGRATED NUTRIENT MANAGEMENT ON WEED INFESTATION AND YIELD OF SOYBEAN IN SOUTHERN GUINEA SAVANNA ZONE OF NIGERIA

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ABSTRACT

*Field trials were conducted at Lapai, Minna and Mokwa Local Governments area of Niger State, Nigeria to evaluate the effects of integrated nutrient management on weed growth and yield of soybean. The study was aimed to determine the effects of integrated nutrient management on weed infestation and yield of soybean. The treatments were: - No-input, Farmers practice (NPK only) at the rate of 200 kg/ha, Agric Lime at the rate of 0.5 tons ha$^{-1}$ + NPK at 200 kg/ha, Agric Lime at the rate of 0.5 tons ha$^{-1}$ + Farmyard manure at the rate of 5 tons ha$^{-1}$ + NPK at the rate of 200 kg ha$^{-1}$ and Farmyard manure at the rate of 5 tons ha$^{-1}$ + NPK at the rate of 200 kg ha$^{-1}$ arranged in a randomized complete block design (RCBD) and replicated three times. Results revealed that, the important weed species of soybeans are Hyptis suaveolens, Tridax procumbens, Digitaria horizontalis, Paspalum scrobiculatum and Commelina benghalensis. Application of No-input reduced weed infestation than in terms of weed density and dry weight. The application of combination of Agric lime + Farm Yard Manure + NPK increased the grain yield of soybean by 56.5 %, 95.3%, 80.0% and 77.4 % in Lapai, Minna, Mokwa and across the location, respectively. It is recommended that farmers in this agro-ecological zone of Nigeria should apply Agric lime + Farm Yard Manure + NPK for higher soybean yield.*

Keywords: Agric lime, Farmyard manure, Integrated nutrient, Soybean, Weed species,

## INTRODUCTION

Soybean [*Glycine max* (L.) Merril] is an important crop commodity widely grown and utilized as a main food source for humans, feed for livestock and as a raw material for oil production (Mamia *et al.*, 2018). At present in tropical Africa, the average seed yield of soybean is below 1 t ha$^{-1}$ as against the world average of 2.7 t ha$^{-1}$ (FAO, 2016). General low yields of food crops in the tropics have been attributed to low soil fertility status, weed infestation, rising cost of agrochemicals, low purchasing power of resource-constrained farmers, lack of improved crop varieties, lack of access to necessary inputs, poor management practices among others (Zerihun and Haile, 2017).

Weeds are a unique group of plants species that infest and thrive in intensively disturbed habitats. In farmlands, weeds compete with crops for most abiotic resources such as nutrients, light and water, and their presence usually results in drastic decline in crop yield and quality. The magnitude of crop yield reduction can be influenced by the weed density, types of weed species present in the field, as well as the weed species persistence and the type of cultural practices in use in the farmland (Kaur and Verma, 2016).

The continuous application of inorganic fertilizer is known to decrease the water holding capacity, organic matter and nutrient content, and the soil microbe population which in turn can decrease the quality of soil fertility (Zerihun and Haile, 2017). Declining soil fertility is one main reason for the slow growth in food production in Sub-Saharan Africa (Zerihun and Haile, 2017). In the same vein, the productivity of soybean is limited due to poor soil and crop management practices. As a result, smallholder farmer yield for the crop is far below the potential production.

However, use of organic manure alone or in combination with chemical fertilizer can improve the physical and chemical properties of the soils; which in turn can provide a good substrate for the growth of microorganisms, and in maintaining a favourable nutritional balance (Gautam and Pathak, 2014). One of such strategy to maintain soil fertility for sustainable soybean production is through the judicious use of fertilizers for higher crop yield (Mamia *et al.*, 2018). It has also been reported that the application of combination of inorganic and organic fertilizers increased soybean yield by 3.5 t $ha^{-1}$ (Yamika and Ikawati, 2012). In order to optimize and maintain healthier soil and achieve sustainable soybean production, we suggest the integration of ameliorant (organic manure and lime) and inorganic fertilizers. Therefore, the objective of this study was to determine the effects of combining NPK fertilizer, agric lime and farmyard manure on weed growth and yield of soybean.

## MATERIALS AND METHODS

On farm study was conducted in Lapai, Minna and Mokwa Local Government of Niger State, located in the Guinea savannah zone of Nigeria. The treatments were (No-input, Farmers practice (NPK only) at rate of 200 kg/ha, Agric Lime at the rate of 0.5 tons $ha^{-1}$ + NPK at 200 kg/ha, Agric Lime at the of 0.5 tons $ha^{-1}$ + Farmyard manure at the rate of 5 tons $ha^{-1}$ + NPK at the rate of 200 kg $ha^{-1}$ and Farmyard manure at the rate of 5 tons $ha^{-1}$ + NPK at the rate of 200 kg $ha^{-1}$) arranged in a randomized complete block design (RCBD) and replicated three times. The soybean seed variety TGX 1987-6f was sourced from the National Cereals Research Institute (NCRI) Badeggi, Niger State. This variety is early maturing and high yielding. Farm yard manure and Agric. lime were sourced in Minna, Niger State and NPK cherifien des- phosphate (OCP) fertilizer was sourced from Morocco where it is manufactured. Lime and manure were applied one week before planting by incorporating them into the soil according to the treatment combinations. Manual weeding was done at 3 and 6 WAS. The NPK fertilizer was applied at 3 WAS by side placement 5 cm away from the plant stands. Soybean was sown at 3 seeds per hole and later thinned to 2 plants per stand at 14 days after planting. The parameters measured were weed importance value index (IVI), weed density and weed dry weight at 9 WAS, number of pods per plant and grain yield. Data collected were subjected to analysis of variance (ANOVA) using the Statistical Analysis System (SAS) version 9.2 software. The Least Significant Difference (LSD) test was used to separate the treatment means at 5% level of significance.

RESULTS AND DISCUSSION

Fourteen, thirteen and eight weed species from 10 different families were identified in soybean across the integrated nutrient management at 9 WAS in Lapai, Minna and Mokwa, respectively (Table 1). Based on the importance value index (IVI), the prevalent weed species infesting soybean field in all the locations were *Hyptis suaveolens, Tridax procumbens, Digitaria horizontalis, Paspalum scrobiculatum* and *Commelina benghalensis* (Table 1). Similarly, weed species such as *Sida acuta, Cyperus rotundus, Vernonia galamensis, Dactyloctenum aegyptium* and *Kyllinga pumila* were predominant in Lapai and Minna only than the other weed species (Table1). In general, five weed species, *Hyptis sua veolens, Tridax procumbens, Digitaria horizontalis, Paspalum scrobicula-tum* and *Commelina benghalensis* were the most important and prevalent in soybeans in our study. This suggests the ecological importance of these weed species and their ability to compete favourably with soybeans for growth resources. Our observations also suggest that the variation in the number of weed species identified during the sampling period might be attributed to the fact that weed species and crops are site specific over a wide range of habitat (Dada *et al.*, 2017).

Weed density differed significantly among the integrated nutrient management at Lapai, Mokwa and the mean (Table 2). Plots with No-input produced the lowest weed density than all the other plots. The application of Agric lime + Farm Yard Manure + NPK produced higher weed density across the locations and the mean. Weed dry weight differed significantly among the integrated nutrient management in Lapai, Minna, Mokwa and the mean (Table 2). The plots with No-input had lighter weed dry weight than all the other plots. Plots with the combined application of Agric lime + Farm Yard Manure + NPK produced heavier weeds in each location and the mean.

Table 1: Weed species composition and their importance value index average across the integrated nutrient management at 9 WAS in Lapai, Minna and Mokwa

| | | Important value index | | |
|---|---|---|---|---|
| Weed species | Family | Lapai | Minna | Mokwa |
| *Sida acuta* Burm.f. | Malvaceae | 10.92 | 14.97 | - |
| *Cyperus rotundus* L. | Cyperaceae | 10.75 | 42.70 | - |
| *Hyptis suaveolens* Poit. | Lamiaceae | 27.78 | 18.77 | 36.33 |
| *Tridax procumbens* L. | Asteraceae | 25.35 | 54.80 | 60.61 |
| *Digitaria horizontalis* Willd. | Poaceae | 31.36 | 20.59 | 62.05 |
| *Paspalum scrobiculatum L.* | Poaceae | 28.56 | 14.97 | 31.18 |
| *Commelina benghalensis* L. | Commelinaceae | 18.39 | 45.77 | 25.13 |
| *Vernonia galamensis* (Cass.) Less | Asteraceae | 11.34 | 12.04 | - |
| *Dactyloctenum aegyptium* (L.) P. Beauv | Poaceae | 12.77 | 14.97 | - |
| *Kyllinga pumila* Michx. | Cyperaceae | 47.44 | 14.97 | - |
| *Panicum maximum* Jacq. | Poaceae | 49.46 | - | - |
| *Calopogonium mucunoides* Desv. | Papilionoideae | 8.62 | - | 25.70 |
| *Cynodon dactylon* (L.) Pers | Poaceae | 8.62 | - | - |
| *Mitracarpus villosus* (Sw.) DC. | Rubiaceae | 8.62 | - | - |
| *Pennieitum pedicellatum* Trin. | Poaceae | - | - | 31.18 |
| *Daniellia oliveri* (Rolfe) Hutch. & Dalz. | Fabaceae | - | - | 27.92 |
| *Senna occidentalis* (L.) Link | Fabaceae | - | 14.97 | - |
| *Ageratum conyzoides* Linn. | Asteraceae | - | 15.45 | - |
| *Ludwigia decurrens* Walt. | Onagraceae | - | 14.97 | - |

Table 2: Weed density and dry weight at 9 WAS in soybean as affected by integrated nutrient management in 2021 rainy season at Lapai, Minna and Mokwa

| | Weed density (no. $m^{-2}$) | | | | Weed dry weight (g $m^{-2}$) | | | |
|---|---|---|---|---|---|---|---|---|
| Treatment | Lapai | Minna | Mokwa | Mean | Lapai | Minna | Mokwa | Mean |
| No-Input | 6.0c | 5.0a | 0.48b | 4.0d | 1.03d | 1.13b | 2.00b | 1.40d |
| NPK only | 9.0bc | 5.0a | 0.57a | 5.0cd | 1.50c | 1.80ab | 5.33a | 2.90bc |
| Agric lime + NPK | 13.0bc | 7.0a | 0.57a | 7.0bc | 2.47b | 2.50a | 5.33a | 3.34ab |
| Agric lime + Farmyard manure + NPK | 21.0a | 7.0a | 0.57a | 10.0a | 3.20a | 2.72a | 5.67a | 3.90a |
| Farmyard manure + NPK | 16.0ab | 7.0a | 0.56a | 8.0ab | 2.42b | 2.14a | 4.33a | 2.10cd |
| LSD (0.05) | 7.81 | 2.97 | 0.53 | 2.61 | 0.40 | 0.99 | 2.28 | 0.80 |

Means with the same letter(s) within the same column are not significantly different from each other using the least significant difference (LSD) test at P≤ 0.05

Table 3: Number of pods and grain yield of soybean as affected by integrated nutrient management in 2021 rainy season at Lapai, Minna and Mokwa

| | Number of pods per plant | | | | Grain yield (kg $ha^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|
| Treatment | Lapai | Minna | Mokwa | Mean | Lapai | Minna | Mokwa | Mean |
| No-Input | 176.0<br>c | 273.0c | 230.0c | 226.0c | 833.33b | 92.27e | 361.10d | 430.23e |
| NPK only | 263.0<br>c | 347.0c | 367.0c | 326.0c | 1037.03b | 979.20d | 962.93c | 990.72d |
| Agric lime + NPK | 480.0<br>b | 659.0ab | 574.0b | 571.0b | 1509.27a | 1361.10c | 1268.58bc | 1379.62c |
| Agric lime + Farmyard manure + | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NPK | 745.0a | 786.0a | 812.0a | 781.0a | 1916.67a | 1981.50a | 1805.53a | 1901.23a |
| Farmyard manure + NPK | 526.0b | 587.0b | 669.0ab | 594.0b | 1638.87a | 1685.20b | 1574.10ab | 1632.72b |
| LSD (0.05) | 141.21 | 182.86 | 159.92 | 181.51 | 466.55 | 252.47 | 358.93 | 179.22 |

Means with the same letter(s) within the same column are not significantly different from each other using the least significant difference (LSD) test at P≤ 0.05

The higher weed density and heavier weeds recorded with the application of Agric lime + FYM + NPK could be attributed to the availability of nutrients in sufficient quantity, and as at when required to support the growth and development of the weeds. This finding is in line with the work of Lukangila (2016) who reported that the application of mineral and organic fertilizers can increase weed pressure either by strengthening the growth of weed seedlings present at the time of the fertilizer application or by stimulating seed germination from seed stock of the past growing season.

Number of pods per plant were significantly different among the integrated nutrient management in this study (Table 3). The application of Agric lime + Farm Yard Manure + NPK significantly produced more pods per plant compared to the other plots. Plots with No-input produced the least pods per plant in each location and mean. Soybean grain yield differed significantly among the integrated nutrient management in all the locations and the mean (Table 3). Plots with the application of Agric lime + Farm Yard Manure + NPK produced the highest grain yield than all the other plots. The plot with No-input had the lowest grain yield in this study. The production of more pods per plant and higher grain yield by the application of Agric lime + FYM + NPK might be attributed to the improvement of the soil physical and chemical properties by the soil amendment and organic manure in providing a favourable medium for the uptake of inorganic fertilizer which in turn supported the increase in the yield and yield characters of soybean. This finding is in conformity with the work of Mamia *et al.* (2018) who reported maximum number of pods per plant, number of seeds per pod, pod length and seed yield of soybean due to adequate supply of nutrient element at the right time from organic and inorganic sources and consequently increased the yield and yield attributes of soybean.

## CONCLUSION

From the results of this study, it is concluded that weed species associated with soybean include *Hyptis suaveolens, Tridax procumbens, Digitaria horizontalis, Paspalum scrobiculatum* and *Commelina benghalensis*. Application of combination of Agric lime + Farm Yard Manure + NPK resulted in the production of highest grain yield of soybean and therefore recommended to soybean farmers in this zone of Nigeria.

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