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Effect of Plant Population and the Rate of NPK Mixed with Poultry Manure on the Yield of Sunflower in Ndele, Rivers State.

Anonaba, N.K and Iyagba, A.G.
Department of Agriculture, Ignatius Ajuru University of Education Rumuolumeni, Portharcourt, Rivers State.Email: apegragba1@gmail.com; Katilauz@yahoo.com

Abstract

A field trial was conducted in the 2020 planting season at the Teaching and Research Farm of the Ignatius Ajuru University of Education, Ndele Campus, Rivers State to determine the effect of plant population and rate of NPK (20:10:10) mixed with poultry manure (PM) on the yield of Sunflower (Helianthus annusL) in Ndele, Rivers State. The experiment was arranged in a 2 x 5 Factorial fitted into a Randomized Complete Block Design with three replicates. The treatment consisted of two plant spacings as Factor A (60cm x 50cm and 50cm x 50cm) and rates of mixture of inorganic fertilizer (NPK 20:10:10) and poultry manure as Factor B (NPK 60kgha^{-1} + PM 10tha^{-1},NPK 60kgha^{-1} + PM 15tha^{-1}, NPK 90kgha^{-1} + PM 10tha^{-1}, NPK 90kgha^{-1} + PM 15tha^{-1} and a control (no fertilizer application). The yield parameters determined were Head diameter (cm) at 8 and 14 weeks after planting (WAP), Flower head weight (g), Number of seeds, weight of seeds (g/plant) at 14 WAP, Dry Matter Accumulation at 4 and 8 WAP and Relative Growth Rate. Data collected were subjected to the analysis of variance (ANOVA) and means separated using the New Duncan Multiple Range Test (DMRT) at $p \leq 0.05$.Results obtained showed that the biggest head diameter ($p \leq 0.05$) was obtained with the application of 60kgha^{-1} of NPK mixed with 15tha^{-1} of PM at a spacing of 50cm x 50cm at 8 and 14 WAP. The greatest number of seeds was with the application of NPK 60kgha^{-1} mixed with 15tha^{-1} of PM at a spacing of 60cm x 50cm while the significant greatest seed weight/plant was by applying 90kgha^{-1} of NPK mixed with 10tha^{-1} of PM. This work therefore, recommends that application of NPK 90kgha^{-1} + PM 10tha^{-1} at a plant spacing of 60cm x 50cm will give a better yield of sunflower at Ndele.

Keywords: Plant population, poultry manure, plant spacing, Sunflower and NPK fertilizer.

Introduction

Sunflower (*Helianthus annus L.*) is an annual flowering plant that is among the economic oilseed in the world. Sunflower is a member of the family of *Asteraceae* and genus *Helianthus* (Andrew *et al*., 2013). Martin *et al*. (2005) unveiled that the hit up for sunflower oil is soaring higher because the oil has a perfect combination of saturated and poly-unsaturated fatty acid which is necessary to break high serum cholesterol level. The health benefits of sunflower include it's ability to improve heart health, boast energy, strengthen the immune system, improve skin health, protect against asthma and reduce inflammation. When sunflower seeds are mixed with sunflower leaves, it increases egg and meat production in poultry and it equally keeps pigs healthy (Anon, 2019).The cultivation of sunflower in Nigeria can be influenced by many factors such as seed variety, weed infestation, pests and diseases, plant spacing and environmental factors. Wide plant spacing gives enough space for the crop to utilize nutrient, space, light and water (Akinola *et al*.,2016) and also improves stem diameter, head diameter and seed weight head (Allan and Gamal,1996).

The application of organic manure as an option to the use of mineral fertilizer is considered a good agricultural practice for small holder farmers in addition to the fact that chemical fertilizers contain little mineral which disperse rapidly in damp soil and give the plant large doses of minerals. Secondly, most farmers in Nigeria are small holders who cannot provide inorganic fertilizers because of its price. In order to sustain soil and healthy crop productivity, it is important to research into alternative soil fertility condition strategies which are effectual and cost effective to farmers particularly the small scale farmers (Raimi *et al*., 2017).

The wholesome result aspiring from the combination of animal and inorganic manure have

been identified as an important indication to crop yield and long term answer to soil degradation. Therefore, there is possibility of combining inorganic fertilizer with poultry manure which is environmentally friendly and at low cost to farmers more especially the small scale farmers. Munir *et al*. (2007) revealed that sunflower hybrid produce a higher yield from a combination of organic manure with chemical fertilizer. Therefore, this study attempts to evaluate the use of combination of inorganic (NPK) and poultry manure at different rates and spacing on the performance and yield of sunflower.

Materials and Method

The experiment was carried out at the Crop Section of the Teaching and Research Farm of the Ignatius Ajuru University of Education, Ndele, Campus, Rivers State in Nigeria (Latitude 4 ^{o} 58 ^{1} N and Longitude 6 ^{o} 48 ^{1} E) (Kalio *et al*., 2009). Ndele is situated in the tropical rainforest zone and is characterized by rainfall periods between April and October. The rainfall distribution is biomodal with peak in July and September couple with low period of precipitation in August. Sunflower (Variety SSL 803) was obtained from the Institute of Agricultural Research and Training of the Ahmadu Bello University, Zaria Nigeria. A land measuring 18m x 5m each was constructed which was further sub-divided into thirty beds measuring 3m x 5m in which the treatments were applied.

The experiment was a 2 x 5 Factorial work arranged in a Randomized Complete Block Design (RCBD) with three replicates. Factor A was the main plot with a plant spacing of 60cm x 50cm with plant population of 33,333.3/ha and 50cm x 50cm with plant population of 40,000.0/ha. Factor B was sub-plot involving a mixture of inorganic fertilizer (NPK 20:10:10) and poultry manure (PM) at different rates and at the following combinations; (i)NPK 60kg/ha + PM 10tha^{-1}, (ii) NPK 60kgha^{-1} + PM 15tha^{-1}, (iii) NPK 90 kgha^{-1} + PM 10tha^{-1} (iv) NPK 90 kgha^{-1} + PM 15tha^{-1} and (v) Control (no poultry manure and no fertilizer application).

Three seeds per hole were planted on the 5th of October, 2020 and later thinned to one per stand after two weeks of germination. Poultry manure was applied two weeks before planting while inorganic fertilizer application (NPK 20:10:10) was administered three weeks after planting. The following parameters were determined at 14 WAP: average Head diameter (cm), Flower head weight (g), Number of seeds, Weight of seeds (g/plant) while Dry Matter Accumulation (g/plant) was at 4 WAP and 8 WAP and Relative Growth Rate. Dry matter accumulation was determined as stated by Hunt (1978):

$RGR = W_2 - W_1 / t_2 - t_1$.

Where RGR = Relative Growth Rate

W_1= Dry weight at first reading

W_2= Dry weight at second reading

t_1= Date at first reading

t_2= Date at second reading

Dry matter accumulation of the crop was ascertained by harvesting two plants per subplot and oven dried at a temperature of 70^{0}C for 4 days and their means obtained. The data obtained from each treatment combination were subjected to the analysis of variance (ANOVA). Significant means were compared and separated using the New Duncan Multiple Range Test (DMRT) at $p \leq 0.05$ level of significance.

Results

from the data obtained in Table 1, it was observed that plant spacing of 60cm x 50cm had the biggest head diameter ($p \leq 0.05$) at 14WAP (16.6cm) were observed with plants treated with NPK 90kgha^{-1} + PM 15 tha^{-1} while the biggest head diameter at 14 WAP (16.6g) were noted with plants treated with NPK 60kg ha^{-1} + PM 15 tha^{-1} with a plant spacing of 50cm x 50cm.

Table 1 also showed that a plant spacing of 60cm x 50cm, the biggest flower head (981.7g/plant) were noted with plants treated with NPK 90kg ha^{-1} + PM 15 tha^{-1} while the biggest flower head (470.7g/plant) at the plant spacing of 50cm x 50cm were noted with plants treated with NPK 60kgha^{-1} + PM 15tha^{-1}($p \leq 0.05$).

Table 1further indicated that plant spacing of 60cm x 50cm gave the highest number of seeds (1280.7) from plants treated with NPK 60kgha^{-1} + PM 15tha^{-1} while the plant spacing of 50cm x 50cm gave the highest number of seeds (1239.3) from the plots treated with NPK 90kgha^{-1} + PM 15tha^{-1}. Table 1 further indicated that a plant spacing of 60cm x 50cm gave significantly the greatest weight of seeds (96.0g) from plants treated with NPK 90kgha^{-1} + PM 10tha^{-1} while the greatest weight of seeds (94.3g) at a plant spacing of 50cm x 50cm were noted with

plants treated with NPK 60kgha^{-1} + PM 15 tha^{-1} ($p \leq 0.05$).

Table 1 revealed also that a plant spacing of 60cm x 50cm, the highest dry matter accumulation at 4WAP (4.1g) and at 8 WAP (31.0g) were observed with plants treated with NPK 90kgha^{-1} mixed with poultry manure 15tha^{-1} while the highest dry matter accumulation at a plant spacing of 50cm x 50cm were recorded with significant difference at 4WAP (4.3g) with plants treated with NPK 60kgha^{-1} + PM 10tha^{-1} and 8WAP (36.2g) with plants treated with NPK 90kgha^{-1} + PM 10tha^{-1}.

Table 1 indicated that plant spacing of 60cm x 50cm gave the highest RGR (1.0g) from plants applied with NPK 90kgha^{-1}+PM 15tha^{-1} while at a plant spacing of 50cm x 50cm, the highest RGR (1.2g) were noted with plants treated with NPK 90kgha^{-1} + PM 10tha^{-1}($p \leq 0.05$).

Discussion

At a plant spacing of 60cm x 50cm, the biggest head diameter (16.6cm) was a result of application of poultry manure which increased the head diameter. This is in agreement with the findings of Wabekwa *et al*. (2010) who made similar observations that application of poultry manure increased head diameter. Mojiri and Arzani (2003) equally confirmed this findings that increased in plant populations decreased head diameters of sunflower. Killi (2004) in his finding noted that lower plant population density produced more head diameter. Flower head at a plant spacing of 60cm x 50cm gave the greatest flower head (981.7g) with the application of NPK 90kgha^{-1} + PM 15 tha^{-1}. This is also in agreement with the findings of Allan and Gamal (1996) who reported that wider spacing in sunflower improved seed weight head. This can be attributed to the fact that increase in NPK and poultry manure enhanced the flower head.

At a plant spacing of 60cm x 50cm significantly gave the highest number of seeds (1280.7/plant). This is in line with the findings of Wabekwa *et al*. (2010) who stated that application of higher poultry manure increased number of seeds. Ujjinaiah *et al*. (19995) equally confirmed it that seed yield of sunflower increased with higher doses of nitrogen (30 to 90 kgha^{-1}). The result from this work equally agreed with Killi (2004) who revealed that total number of seeds per head, seed yield per head and 1000-seed weight were highest with the lowest plant population. This may be as a result of sufficient environmental resources in wider spacing and less competition between plants as well as increased light penetration within plant canopy which enhanced assimilation and oil formation (Khan *et al*., 2003; Ara *et al*., 2007). Plant spacing of 60cm x 50cm significantly ($p \leq 0.05$) led to the biggest weight of seeds (96.0g) were observed from plots treated with NPK 90kgha^{-1} mixed with PM 10tha^{-1}. This is as a result of wider spacing which improves weight of seed and a similar result was noted by Morrison *et al*. (1990) who stated that well spaced plants received more solar radiation and are more photosynthetically efficient than closely spaced ones.

This work showed that the highest dry matter accumulation at 4 WAP (4.3g) and at 8 WAP(36.2g) were recorded with a plant spacing of 50cm x 50cm which revealed that there was higher dry matter accumulation in closer spacing. At a plant spacing of 50cm x 50cm, the highest RGR (1.2g) was significantly ($p \leq 0.05$) with plants treated with a combination of NPK 90kgha^{-1} and PM 10tha^{-1}. This is in agreement with the findings of Galanopoulou-sendouka *et al*. (1980) who equally noted that there was higher total dry matter production in close spacing. The work showed that interaction between between plant spacing and fertilizer mixture caused significant differences in weight of seed.

Conclusion: The results of the study on the effect of plant population and the rate of NPK mixed with poultry manure on the yield of sunflower in Ndele, Rivers State indicated that a plant spacing of 60cm x 50cm will lead significantly to higher flower head (NPK 90kgha^{-1} + PM 15tha^{-1}) while significant ($p \leq 0.05$) highest seed weight was with the application of NPK 90kgha^{-1}+ PM 10tha^{-1}.

Recommendation: For good yield of sunflower, application of NPK 60kgha^{-1} mixed with 15tha $^{-1}$ of PM at a spacing of 60cm x 50cm should be adopted. However, further research should be conducted that will involve other sources of organic manure mixed with inorganic fertilizer to determine the yield response of sunflower.

Table 1: Effect of combination of inorganic (NPK) and poultry manure at different rates and spacing on the performance and yield of Sunflower

Treatments:	Head diameter (g)		Flower Head	Number of seeds	Weight of seed (g/plant)	Weight of seed/ha (tons)	Dry matter Accumulation (g)		Relative Growth Rate
	8WAP	14WAP	14WAP (g)	14WAP	14WAP	14 WAP	4WAP	8WAP	
Plant population: 60cm x 50cm									
NPK 60kgha^{-1}+ PM 10tha^{-1}	6.0c[1]	13.4b	234.3d	807.3c	44.3c	1.48c	3.3b	27.8a	0.9a
NPK 60kgha^{-1}+ PM 15tha^{-1}	8.2a	15.7a	668.0c	1280.7a	75.3b	2.51b	3.6b	21.8c	0.7b
NPK 90kgha^{-1}+ PM 10tha^{-1}+	5.7c	13.3b	815.3b	952.7b	96.0a	3.20a	3.4b	27.5b	0.9a
NKP 90kgha^{-1}+ PM 15tha^{-1}	7.0b	16.6a	981.7a	680.3d	48.7c	1.62c	4.1a	31.0a	1.0a
0 fertilizer	3.3d	6.3c	233.0d	268.7e	40.7c	1.36c	2.4c	11.3d	0.3c
Mean	6.0	13.1	586.5	797.9	60.6	2.03	3.4	23.9	0.7
S.E. ±	0.8	1.8	38.0	165.7	10.3	0.25	0.3	3.5	0.1
Plant population 50cm x 50cm									
NKP 60kgha^{-1}+ PM 10tha^{-1}+	7.3b	14.3a	397.0b	941.3b	65.0b	2.60	4.3a	34.7a	1.1a
NPK 60kgha^{-1}+ PM 15tha^{-1}	8.3a	16.6a	470.7a	842.7c	94.3a	3.77	3.4c	30.5a	1.0ab
NPK 90kgha^{-1}+ PM 10tha^{-1}	6.6c	13.9a	364.3b	776.7c	40.7c	1.63	3.2c	36.2a	1.2a
NPK 90kgha^{-1}+ PM 15tha^{-1}+	7.1b	14.9a	360.7b	1239.3a	66.0b	2.64	3.8b	26.7b	0.8c
0 Fertilizer	5.3d	10.9b	204.3c	340.3d	30.3d	1.21	2.3d	7.3c	0.2d
Mean	6.9	14.1	359.4	828.1	59.3	2.37	3.4	27.1	0.4
S.E. ±	0.5	3.1	43.4	145.1	11.1	0.20	0.3	5.2	0.1
Interaction PxF	NS	NS	NS	NS	3.6	NS	NS	NS	NS

[1]Mean is a set of treatments followed by the same letter(s) are not significantly different (P≤0.05) using DMRT
NS = [2]Not Significant, P = Plant spacing, F= Fertilizer rates

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