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Full Length Research Article

PERFORMANCE OF COTTON/MAIZE MIXTURE AS INFLUENCED BY NITROGEN AND PLANTING PATTERN AT SAMARU NIGERIA

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ABSTRACT
Two field trials were carried out during 2017 and 2018 wet seasons at the Institute for Agricultural Research, Ahmadu Bello University Research farm to investigate the effect of different levels of nitrogen and planting pattern on the performance of cotton/maize mixtures. The treatment consisted of four levels of nitrogen (0, 60, 90 and 120 kg/ha) and four planting patterns (sole crop, 1:1, 2:1 and 3:1) cotton/maize mixtures arranged in a randomized complete block design with three replications. Each plot comprised of four ridges of 5 m long given a gross plot of 15 m^2. SAMCOT 9 and SAMMAZ 51 where the two maize varieties planted. All the required agronomic practices were duly observed. Data were measured on plant height, number of days to 50% tasseling/flowering and grain yield. Results showed that each increase in nitrogen levels from the control to the highest rate of 120 kg N/ha led to a significant increase in plant height and grain yield in all the seasons while decreased days to 50% tasseling/flowering. Cotton/Maize mixture at 1: 1 significantly gave taller plants, took longer days to attend 50% tasseling/flowering and higher grain yield while 3:1 cotton/maize mixtures gave taller plants, took longer days to 50% tasseling/flowering and highest ball yield. For good performance of cotton/maize mixture in the study area, farmers are advised to apply 120 kg N ha^{-1}, using cotton/maize mixtures at 3:1 for good cotton ball yield and 1:1 cotton/maize respectively for better maize yield.

Keywords: Cotton-maize mixtures, nitrogen, planting pattern, Samaru, Nigeria.

INTRODUCTION

Cotton the king of fibers is an industrial crop of worldwide importance, it is one of the most important commercial crop playing a key role in the economic and social affairs of the world including Africa and Nigeria in particular. The drastic set back in cotton production in the country in recent years may be attributed to closure of most of the country's textiles and massive importation of textile and its products from china coupled with low producer price of the crop forcing farmers to abandon cotton production for soybean, sesame and other crops that fetch farmers more money. However with the recent attention placed on the crop by President Buhari's Government, many farmers in Katsina, Zamfara, Kano and Gombe States are massively growing the crop (Saad, 2024). Maize production and consumption has increased dramatically in the country for use as food and feeds to livestock and other industrial needs. It replaces the dominant crops such as millet, sorghum because of inherent attribute of the crops such as easy to cultivate, harvest, transport store and high yield per unit area. It is cultivated from the rain forest region in the south to the Sahel region in the north (Lorenzo, 2024). Small scale farmers in Nigeria and other African countries never grow single crop nowadays, mainly attributed to food security situation. In case of disease and pests outbreak, drought or any other calamity, a farmer may harvest something for his family and or market. Thus growing cotton/maize mixture is a common practice among cotton farmers in the cotton growing areas of the country (Saidou *et al.*, 2012).

The major limiting factors to cotton/maize production especially in Sudan and Sahel regions is the plant nutrients supply especially nitrogen. One important characteristics of maize is its high and rapid nutrient requirement for good growth and yield. The soil must be supplied about 50 to 60 kg N (inform of soluble nitrates) and 30 kg P ha^{-1} in plants available form for each ton of grain produced (Wuber & Hamma, 2013). Similarly, Hamma & Ibrahim (2013) reported maize grain to contain 2% that is, 100 kg of harvested grains contains 2 kg N. It is therefore important to plant the crop in a fertile field that will guarantee the supply of essential nutrients for good growth and yield. The study therefore was carried to provide an insight of how the mixture of cotton/maize responds to varying nitrogen levels and planting pattern.

MATERIALS AND METHODS

The trials were successfully carried out at the experimental station of the Institute for Agricultural Research (IAR), Ahmadu Bello University Zaria from 2017 to 2018 rainy seasons respectively. The treatments consisted of four nitrogen levels (0, 60, 90 and 120 kg N ha^{-1}) and four planting patterns: sole crops; 1:1; 2:1 and 3:1 cotton/maize mixtures. The treatments were arranged in a Randomized Complete Block Design (RCBD) and replicated three times. Land was cleared, harrowed and ridged. SAMCOT 9 and SAMMAZ 51 where the cotton and maize varieties planted at 75 cm inter-row and 25 cm intra-row spacings. Plot size used was 5 m x 3 m given a gross plot of 15 m^2. All the required Agronomic practices where duly observed. Data collected included, plant height, number of days to 50% flowering/silking, grain yield, land equivalent ratio and area time equivalent ratio and green/bull yield. Analysis of variance was carried out using SAS (2002) and significant means were separated using Duncan Multiple Range

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Test at 5% level of probability (Snedecor & Cochran, 1967).

RESULTS AND DISCUSSION

The effects of nitrogen and planting arrangements of cotton/maize mixture on plant height is presented in Table 1. Each increase in nitrogen rate from 0 to 120 kg N ha^{-1} led to a significant increase in plant height of both crops and seasons. This could be attributed to the positive role of nitrogen in promoting cell division, cell expansion and cell growth that promote the growth and elongation of internode thus resulting in the production of taller plants associated with higher nitrogen rates. Hague *et al*. (2001) reported that nitrogen is a component of protein and nucleic acids and hence affects growth. Muhammad *et al*. (2024) also observed increase of growth parameters with corresponding increase in fertilizer application on three maize varieties in Samaru northern guinea savanna. Dai *et al* (2011) reported that the maximum yield per plant often depends on appropriate nitrogen supply. A number of researchers reported responses of nitrogen up to 80 kg N and 100 Kg N (Meng *et al.,* 2011) and 120 kg N ha^{-1} and in northern guinea savanna (Abdullahi *et al*., 2022). The performance of nitrogen to growth parameters of maize in this trial is similar to the observations of Mani *et al*. (2024) on maize in northern guinea savanna. Planting cotton/maize mixture in the ratio of 1:1 resulted significantly ($p \leq 0.05$) to taller plants than the arrangements, this could be attributed to competition for growth resources there by leading to competition thus grow taller in order to obtain the available sunlight for the manufacture of assimilate needed for growth and development. Similar observation was reported by (Yooussouf, 2023).

Days to 50% flowering of both crops is presented in Table 1. In both cotton and maize crops as well as the cropping seasons, the control plots took longer days to attain days to 50% flowering than well fertilized crops. This was attributed to the performance of fertilizer in promoting good and early growth development and yield of crops. Similar observation was reported by Mani *et al.* (2015) that growth period in maize was reduced due to good management and adequate fertilizer application on maze. Furthermore, Mani *et al*. (2024) reported significantly decrease in number of days to flowering on watermelon when NPK fertilizer was applied in contrast to 5 tons ha^{-1} poultry manure (PM) or NPK 50-25-25 + 2.5 tons PM were use respectively. Sole crop of cotton and maize significantly took longer days to attain 50% flowering followed by 1:1 cotton/maize mixture. The observation was attributed to the less competition for growth resources especially water, light and nutrients when compared to the high ratios. This supported the observation reported by Hussaini *et al*. (1996). Nitrogen influences processes involved in crop growth and development, promoting morphophysiological changes related to photosynthesis, root development and root activity, ionic nutrient element uptake, cell enlargement and differentiation (Costa *et al*., 2005). Farmers who were aware of fertilizer residual effect, introduced cotton rotation with maize in order to enhance the cereal production through the residual effect of fertilizer applied for preceding cotton (Saïdou *et al.,* 2004).

Results on the effects of N fertilizer and cotton/maize mixtures on grain yield in presented in Table 2. The result revealed that each increase in nitrogen level was accompanied with significant increase in bulb and grain yield across the years and combined. This was due to the importance of nitrogen in cell division, cell explanation and growth. Application of nitrogen caused an increase in leaf area and photosynthetic rate and thus increase dry matter production thereby increasing yield of crops (Reddy & Amin, 2022). Nitrogen is usually more responsible for increasing plant growth than any other nutrient. Shortage of N can cause slow growth, reduced leaf size, yellowing, short branches/inter nodes, premature fall, yellowing and leaf drop, and increase the likelihood of some diseases. An overabundance can cause excessive shoot and foliage growth, reduced root growth, low plant food reserves and increased susceptibility to environmental stresses and some plant diseases (Geri, 2012). Application of nitrogen could be attributed to the important role nitrogen played as a constituent of protein, also main components of various other essential compounds needed for plant growth process such like chlorophyll and many enzymes (Onasanya *et al*., 2009; Amin, 2022).

Conversely sole crops of both cotton and maize resulted in significantly higher grain yield followed by 3:1 for cotton and 1:1 for maize respectively. This could be explained from the fact that crop planted sole are devoid of overcrowding and or shading, thus grow luxuriously without restrictions as well those grown 3:1.

Conclusion

Based on the results obtained in this study it can be concluded that growing cotton/maize mixture using 120 kg N and 3:1 for cotton and 1 100 120 kg N and 1:1 for maize could be adopted and promoted in the study area.

Table 1: Cotton/ maize mixture as influenced by nitrogen and planting arrangement on plant height at Samaru, Nigeria

	Plant Height (cm)				Days to 50% flowering/tasseling			
	2017		2018		2017		2018	
Treatment	**Cotton**	**Maize**	**Cotton**	**Maize**	**Cotton**	**Maize**	**Cotton**	**Maize**
Nitrogen level (kg ha^{-1})								
0	60.5d	100.8d	70.5d	110.8d	57.0a	63.0a	60.0a	65.0a
60	110.5c	122.8c	120.8c	132.8c	54.7b	61.5b	57.7b	63.5b
90	123.7b	136.3b	133.7b	146.3b	53.8c	60.0c	55.8c	62.0c
120	138.6[a]	151.0a	148.6a	161.0a	50.5d	57.0d	53.5d	59.0d
SE (±)	3.20	3.20	3.30	3.42	0.63	0.63	0.65	0.62
Planting arrangement								
Sole crop	118.0a	144.4a	128.0a	154.4a	56.7a	66.3a	58.7a	69.3a
1:1	100.0c	134.4b	110.0c	144.4b	54.3b	64.3b	56.3b	67.3b
2:1	105.5d	120.0a	115.5b	130.0c	53.0a	62.6c	55.0c	65.6c
3:1	115.0c	115.0c	120.0b	125.0c	52.0d	60.3d	54.0d	63.3d
SE (±)	3.20	3.20	0.30	0.32	0.62	0.60	0.65	0.63
Interaction								

N x P	NS	NS	NS	NS

Means followed by same letter are significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level. NS = Not significant, N = nitrogen, P = planting arrangement

Table 2: Cotton/ Maize Mixture as Influenced by Nitrogen and Planting Arrangement on grain yield at Samaru

	Plant Height (cm)					
	2017			2018		
Treatment	**Cotton**	**Maize**	**Combined**	**Cotton**	**Maize**	**Combined**
Nitrogen level (kg ha^{-1})						
0	664.3d	382.6d	513.5d	644.3d	392.6d	518.5d
60	1514c	1211c	1363c	1524c	1221c	1373c
90	1716b	1443a	1580b	1726b	1453b	1590b
120	2352a	1789b	2071a	2362a	1799a	2081a
SE (±)	60.9	57.8	60.0	63.9	53.8	61.4
Planting arrangement						
Sole crop	1910a	2409a	2160a	1930a	2419a	2175a
1:1	1285d	1444b	1365b	1305d	1454b	1380c
2:1	1356c	1377c	1367b	1466c	1387c	1427b
3:1	1595b	1147d	1372b	1605b	1157d	1381d
SE (±)	60.9	57.8	60.1	60.9	60.8	60.9
Interaction						
N x P	NS	NS	NS	NS	NS	NS

Means followed by same letter are significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level. NS = Not significant, N = nitrogen, P = planting arrangement

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