ANALYSIS OF GROWTH AND DEVELOPMENT OF MAIZE IN RESPONSE TO INTEGRATION OF POULTRY MANURE WITH CHEMICAL FERTILIZERS IN MAIZE (*Zea mays* L.)

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ABSTRACT

The experiments were carried out in experimental farm at faculty of agriculture, Annamalai University during 2015, with an objective to explore the response of maize to incorporation of graded dose of poultry manure and chemical fertilizers. Twenty different treatments with two replications each were carried out in the plot in RBD design. The percent increase in grain yield ranged from (41.5 to 100.8) and stover yield ranged from (21.8 to 41.6) due to poultry manure alone. The percent increase in the grain yield ranged from (24.4 to 81.7) and Stover yield ranged from (10.7 to 35.6) due to fertilizer alone and percent increase in grain yield ranged from (51.5 to 235.5) and stover yield ranged from (16.6 to 78.9) due to poultry manure and fertilizers. The highest grain yield 6214.3 kg ha^{-1} and stover yield 8454 kg ha^{-1} was noticed with poultry manure @6 t ha^{-1} + 100 % NPK.

Introduction:

Maize is one of the most important cereal crop in the world agriculture as food, feed, and industrial raw material which ranked third largest cereals following rice and wheat respectively. It is grown across a wide range of agro ecological zones, due to its wider adapatability. Maize is considered as the "Queen of cereals". Maize has great nutritional value as it contains about 72% starch, 10% protein, 4.8 % oil, 8.5 % fiber, 3% sugar and 1.7% ash (Chaudhary,1993).Among the various agronomic practices for increasing productivity of crops, nutrient management play an important role. Mineral fertilizers were used to provide soil nutrients in order to maintain optimum soil fertility conditions, health growth of the plants and quality yield. Chemical fertilizers help the growing of the crops to with stand stress conditions and in some cases these were used to correct the nutrient deficiencies. There are also various reports on the preference of mineral fertilizer in the growth and productivity of crops (Akinrinde,2006;Nweke and Nsoanya,2013).Nitrogen, Phosporous and potassium fertilizers are required by the greatly by the crops for healthy development and crop quality. Poultry manure is an excellent organic fertilizer, as it contains high N,P,K and other essential nutrients. In agriculture the main reason for apply poultry manure include the organic amendments of the soil and the provision of nutrient to the crops (Warren *et al*.,2006) .in contrast to chemical fertilizer it adds organic matter to the soil which improves soil structure, nutrient availability.

Materials and methods:

A field experiment was conducted in the field No.GL12D of the experimental farm, Department of agronomy, Faculty of agriculture, Annamalai university, Annamalai nagar during February-May, 2016. Experiment site is situated at latitude of 11˚24' N and 79˚41' E longitude at an altitude of +5.79 meters above mean sea level. The soil of the experimental field was clay loam in texture with a pH of 7.2, the soil was low in available nitrogen(210.97) medium in available phosphorous and high in available potassium (320).the experiment was laid out in a randomized block design with 20 Treatment

combinations of organic manures and fertilizer levels. The maize hybrid variety NK 6240 of 100-105 days duration was chosen for this experiment and raised with a spacing of 60 × 20 cm .

The data recorded in respect to different observation in the study were analysed statistically with the help of computer following the MSTAT procedures for RBD as suggested by cochrean and cox 1977, the standard error of mean was calculated in each case and critical difference at 5% level of probability was worked out for comparing treatment means, whenever F test was found significant. The data on plant growth recorded at 30 DAS, 60 DAS and at harvest. The following biometric observations of Plant height, LAI, Dry matter production, Cob length, Cob diameter, Grain number, Cob $^{-1}$,test weight, Grain yield, Stover yield were recorded.

Results and discussion

Plant height

It is one of the most important trait in determining the vigour and potential of any crop. Stature of the plants leads to structure and capacities to capture sunlight to assimilate photosynthates by virtue of more leaves. Plant height increased linearly with levels of poultry manure, application of 6 t ha $^{-1}$ of poultry manure(O_3) recorded the highest plant height of 92.7,214.6 and 243.3 cm at 30 DAS,60 DAS and at harvest respectively.

Plant height increased linearly with the fertilizer levels. The treatment (F_4)100% RDF recorded the highest plant height of 92.6,209.1 and 239.6 cm at 30 DAS,60 DAS and at harvest respectively.

Interaction between poultry manure and fertilizer dose caused significant increase in the plant height compared to their individual applications. Accordingly all stages, application of 6 t ha^{-1} poultry manure+100% RDF registered the highest plant height of 106.7,259.4,289.2 cm at 30 DAS,60 DAS and at harvest respectively. This treatment caused 215.3 percent increase over control. It was significantly superior to rest of the interaction. The lowest plant height was recorded with treatment O_0F_0.

Growth promoting effect of N on Plant can be explained on the basis of the fact that N supply increases the number and size of meristamatic cells which leads to the formation of new shoot (Lawlor, 2002). Furthermore, N application is known to increase the level of cytokinin which affect cell wall extensibilities (Lawogbomo and Lawogbomo,2009, Cyrus *et al*.,2010).It is therefore logical to speculate that N was involved directly or indirectly on the enlargement and division of new cells and production of tissues. The result agreed with the findings of Mankinde, (2007), Ayola and Makinde, (2008), Ayola and Makinde, (2009), Iqbal *et al*.,(2010), Abd El-Fattah *et al*.,(2012) and Enujeke (2013) who reported better height of maize treated with organo-mineral fertilizer.

Leaf area index

Increased leaf area implication for light interception and DMP to support plant growth and yield (Vargas *et al*., 2002; Board, 2004).In case of any plant, leaves are important organs which have an active role in photosynthesis. To achieve high yield, maximization of leaf area is an important factor of the crop. Leaf area index increased at both stages with either addition of graded levels of poultry manure or fertilizers. Leaf area index increased progressively with levels of poultry manure, application of 6 t ha $^{-1}$ of poultry manure (O_3) recorded the highest leaf area index of 3.1 and 6.2 at 30 DAS and 60 DAS and significantly superior to rest of the poultry manure.

Leaf area index increased progressively with fertilizer levels. The treatment (F_4) 100 % RDF recorded the highest leaf area index of 3.1 and 6.0 at 30 DAS and 60 DAS. The lowest leaf area index was recorded with the treatment (F_0) no fertilizer.

Interaction between poultry manure and fertilizer dose caused significant increase in the leaf area index compared to their individual applications. Accordingly all stages, application of 6 t ha^{-1} poultry manure+100% RDF registered the highest leaf area index of 3.8 and 7.4 at 30 DAS and 60 DAS respectively. This interaction excelled superiorly over other treatment combinations and control plots. The lowest leaf area index was recorded with treatment O_0F_0.This treatment caused 217.3 per cent increase over control. Aziz *et al*., (2010) found poultry manure enhanced the leaf area index (LAI).The increasing trend of LAI with INM can be attributed to the positive effect of nitrogen on both leaf development and leaf area duration of the crop (Fageria,2007; Fageria and Baligar,2005).

Dry matter production

The increase in dry matter production was the cumulative effect of increase in various growth characters like plant height, tiller count, LAI, RGR and NAR. The drymatter accumulation is considered to be the reliable index of the crop growth. The per cent increase in DMP ranged from 52.7 to 131.0 due to poultry manure alone, ranged from 31.5 to 105.3 due to poultry manure alone and ranged from 73.0 to 346.3 in conjoint application.

Poultry manure had been reported to contain essential nutrient elements that are associated with increased photosynthetic efficiency which promotes more vigorous growth, improved meristamatic and physiological activities in the plant , as well as improve the soil properties, there by resulting in the synthesis of increased photo-assimilates that enhanced maize yielding ability (Boateng *et al*.,2006). Dry matter production increased with the levels of poultry manure, application of 6 t ha^{-1} of poultry manure (O_3) recorded the highest drymatter production 1664.5,6148.6 and 14681.7 kg ha^{-1} at 30 DAS,60 DAS and at harvest respectively

Dry matter production increased with the fertilizer levels. The treatment (F_4) 100% RDF recorded the highest dry matter production of 1613.3,5969.8 and 14321.9 kg ha^{-1} at 30 DAS,60 DAS and at harvest respectively. The lowest dry matter production was recorded with the treatment(F_0) no fertilizer. Ibeawuchi *et al.*(2007) reported that 8 t ha^{-1} of poultry manure resulted in significantly higher dry matter of maize. The increase in DMP can be due to the synergistic effect of combination of organic and inorganic fertilizer that enhanced nutrient release and availability improved nitrogen and other macro and micro elements absorbtion by the maize plant.

Yield attributes

Cob length and cob diameter

Cob length and cob diameter increased with levels of poultry manure. Application of 6 t ha^{-1} of poultry manure (O_3) recorded the highest cob length of 21.3 cm and cob diameter of 10.4 cm and significantly superior to rest of the levels of poultry manure (O_0). Cob length and cob diameter increased linearly with fertilizer levels. The treatment (F_4) 100 % RDF recorded the highest cob length of 20.9 cm and cob diameter of 10.3 cm.

Accordingly application of 6 t ha^{-1} of poultry manure +100 % RDF recorded the highest cob length of 25.3 cm and cob diameter of 12.4 cm.

Incorporation of poultry manure or fertilizer alone or conjoint application caused a significant impact on yield attributes *viz*., cob length, cob diameter, number of grains cob^{-1} and 100 grain weight over control. Poultry manure has been reported to contain about 16 kg nitrogen, 20 kg phosphorous (P_2O_5) and 12 kg potassium (K_2O) per hectare including micronutrients (Cooperband,2002).It promotes soil structure, soil tilth, cation exchange capacity, water holding capacity, water holding capacity and crumb formation. It also promotes infiltration, protects against erosion and facilitates the spread and penetration of plant roots. In addition, the slow release nature of organic fertilizer prevents loss of nutrients through leaching and enhances synchronization of nutrient release with uptake by the crop.

Number of grains cob^{-1} and 100 grain weight

The higher yield attributes under combined application of organics and inorganics might be due to higher levels of inorganic fertilizer that have increased the activity of photosynthesis and enzymes which is responsible for transformation of energy, carbohydrates , fat metabolism and respiration of the plant. Number of grains cob^{-1} and 100 grain weight increased linearly with levels of poultry manure, application of 6 t ha^{-1} of poultry manure (O_3) recorded the highest number of grains cob^{-1} of 381 and 100 grain weight of 31.6 g and significantly superior to rest of the levels of poultry manure.

Number of grains cob^{-1} and 100 grain weight increased linearly with fertilizer levels. The treatment (F_4) 100 % RDF recorded the highest number of grains cob^{-1} of 374 and 100 grain weight of 31.1 g.

Accordingly application of 6 t ha^{-1} of poultry manure+ 100% RDF recorded the highest number of grains cob^{-1} of 448 and 100 grain weight of 35.4 g. The lower number of grains cob^{-1} and 100 grain weight was recorded with treatment O_0F_0.This findings is in line with the view of Ndukwe *et al*.(2014) that the integration of organic and inorganic fertilizers in maize production is beneficial and sustainable. Similarly,Adeniyan and Ojeniyi (2005) found that integrated application poultry manure and NPK fertilizer increased maize yield components compared with poultry manure or inorganic fertilizer application alone. On an average, per cent increase in yield attributes due to best combination over poultry manure alone @ 6 t ha^{-1} was 65.7 and over 100% NPK alone was 55.9.

Grain and stover yield

Grain yield usually depends upon various factors such as status of soil fertility, water availability, crop management, agronomic practices, environmental factors and plant genetic characteristics. Application of 6 t ha^{-1} of poultry manure (O_3) recorded highest grain yield of 5213.7 kg ha^{-1} and stover yield of 7587.7 kg ha^{-1}. Grain yield and stover yield increased linearly with the fertilizer levels. The treatment (F_4) 100 % RDF recorded the highest grain yield of 5077.7 kg ha^{-1} and stover yield of 7471.3 kg ha^{-1} .

Interaction between poultry manure and fertilizer dose caused significant increase in grain yield and stover yield compared to their individual application. Accordingly at all stages application of 6 t ha^{-1} of poultry manure+100% RDF recorded the grain yield of 6214.3 kg ha^{-1} and stover yield of 8454 kg ha^{-1} .This interaction excelled significantly over other treatment combinations and control. Ibeawuchi *et al*.(2007) reported that 8 t ha^{-1} of poultry manure resulted in significantaly higher grain yield, drymatter and LAI of maize.

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