

GROWTH, YIELD AND YIELD COMPONENTS RESPONSE OF PEPPER (*CAPSICUM ANNUM*) TO APPLICATION OF NPK, FARM YARD MANURE AND CROP RESIDUES

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ABSTRACT

Experiments were conducted on the response of NPK, farm yard manures and crop residues on the performance of *Capsicum annum* during 2017 and 2018 seasons. The treatments were: Control (CO): Maize Residue (MR), Groundnut Residue (GR), Pig manure (PGM), Cow – Dung (CD) applied at 5t/ha, NPK fertilizer (120t/ha) and Control (00t/ha). These were arranged in a Randomized Complete Block Design (RCBD) and replicated three times. Data on Agronomic traits (Plant height, number of leaves and leaf area); yield components (number of flower, fruit length (cm) and fruit yield (t/ha) and residual were taken. Data collected were analyzed using Analysis of Variance and the significant means were separated by Duncan Multiple Range Test (DMRT) at 5% of significance. Tallest plant (31.63 cm), highest number of leaves (59.29), highest leaf area (53.9 cm²), highest number of flowers (42.17), highest fruit length (8.09 cm), average fruit yield (24.99t/ha) were produced by NPK fertilizer at 120 kg/ha followed by PGM with plants (25.94cm), (34.04) leaves/plant, (44.6cm²) leaf area, (34.64) flower, (6.47 cm fruit length) and (19.10t/ha) fruit yield/ha were recorded in the first season. The organic manures gave higher residual with PGM being the best. Farm yard manures performed better than crop residues while PGM had higher value than CD and GR better than MR in both seasons of evaluation. Thus, the use of NPK fertilizer at 120kg/ha and either farmyard manure (PGM/CD) or crop residue at 5t/ha are recommended for sustainable production.

Key words: NPK fertilizer, farmyard manures, crop residues, growth, yield and *Capsicum annum*

INTRODUCTION

Pepper is an important crop species in the world. It is one of the most important vegetables grown in Nigeria and other parts of the humid and semi-arid tropics (Aliyu, 2000). It is commonly used as condiments (Alabi, 2006) and the non-pungent species (*Capsicum annum*) are eaten raw as salad while the stronger flavoured types (chilies) are popular in all kinds of cookery as pungent species. It is also used in seasoning sauces and soup and other dishes. It is used as a medicinal plant and for the prevention and

treatment of cold and fever (Udoh *et al.*, 2005). Adequate soil fertility is one of the requirements for profitable vegetable production (Bello and Haftom, 2008). Nitrogen is the most yield-limiting nutrient. Hence; N management is critical for optimum vegetable yield. Similarly, Adepetu, (1997) noted that the downward trend in food production should prompt farmers to amend the soils with different materials in order to supply the nutrients required to enhance growth and yield of crops. With respect to this,

several organic materials have been recommended to subsistence farmers in West Africa as soil amendments for increasing crop yields including cow dung, poultry dropping, pig dung and refuse composts Olayinka *et al.*, (1998). The improved management practice is to use these external inputs from organic and inorganic sources to supply nutrients to plants.

The use of inorganic fertilizer to increase yield has been found to be effective as a short term solution which demands constitute the use on a long term basis. The hazardous environmental consequence and high cost of inorganic fertilizers make them not only undesirable but also uneconomic and unaffordable (Oyedemi *et al.*, 2014). Also, inorganic fertilizers have been confirmed to pose a great threat to environmental sustainability (Aiyelagbe, 2011). The use of inorganic fertilizers have not been helpful under intensive agriculture because it is often associated with reduced crop yield, soil acidity and nutrients imbalance (Obi and Ebo, 1995). With all these negative effects of inorganic fertilizer on agricultural land and environment, there is the need to explore alternative ways to improving soil fertility and ensure food security. Over the years, farmers and researchers are shifting to the use of organic fertilizers like compost, cow dung and poultry manure (Nguyen, 2010).

The management of a crop residue can contribute to increased nutrient cycling and greater crop yields (Cruse and Herndl, 2009) and also have an important role in reducing soil erosion and maintaining yield (Kouyate *et al.*, 2000). Similarly, the rate of decomposition and N mineralization increases by increasing the quality of a plant residue (Jensen *et al.*, 2005). Although the quality of a residue is an important factor to determining the C and N mineralization rate, residue management is a factor affecting this process (Smith and Sharpley, 1990). The amount of nutrients released during the decomposition of a crop residue is very important in both organic and conventional farming systems. In the organic farming system, it has a decisive influence on crop yield and in the conventional farming system, it could lead to a reduction in mineral fertilizer application (Kwabiah *et al.*, 2003).

Now days, farm yard manure recycling is one of the main options adopted in agriculture because its compost is rich with plant nutrients, especially N and P and are effective long lasting amendments (Bello *et al.*, 2015). Animal

manure, especially cattle dung is another source of nitrogen and other nutrients, which can decrease the demand of chemical fertilizers, and it has been used for many centuries to increase soil fertility (Darzi, 2012). Thus, farmyard manure can improve chemical, physical and biological characteristics of soil (Darzi and Haj Seyd Hadi, 2012).

This study was therefore conducted, aimed at evaluating the response of NPK fertilizer, farm yard manures and crop residues on growth, yield and yield components of pepper (*Capsicum annum*).

MATERIAL AND METHODS

Field trials were conducted at Oyo State College of Agriculture, Igbo-ora spanning from 2017 - 2018 cropping seasons. Igbo-ora town is located in Ibarapa zone; the northern part and derived Savannah Zone of South Western Nigeria. It is located between 7°15' and 7°33'N, and 3°56'-3°57' E. Pepper seedlings were raised in a nursery with sterilized top soil. Seeds were planted 5cm apart. Sowing depth was about 5mm. Nursery beds were made under shade to protect the seedlings from direct impact of rain drops and sunlight. Watering of the nursery was carried out regularly on daily basis. Germination began a week after planting in the nursery.

Before planting, soil samples were taken from different spots using random sampling method with the aid of soil auger at depth of 0 to 15cm and thoroughly mixed to form a composite sample. Routine chemical analysis of the soil was performed in the analytical laboratory of the College for pH, organic carbon (C), total nitrogen (N), available P, exchangeable Ca, K, Na and Mg. The pH was evaluated in water (1:2, soil water ratio) using pH meter with glass electrode in distilled water. Total nitrogen was determined using the Kjeldhal procedure method. The organic carbon content was determined using the Walkley-Black method, available P content was determined using Bray P-1 method while exchangeable Ca, K, Na and Mg were determined using Flame photometry. Seeds of variety F1 306 was collected from NIRHORT. The seedlings were transplanted to the field after four weeks of planting. Transplanting was done with a hand fork with ball of earth around the roots. Each plot measured 2m x 2m with an inter plant space of 30cm x 75cm, giving a total of 18 plants per plot. The experiment was arranged in a Randomized Complete Block Design. The six

treatments were: 5t/ha of piggery manure (PGM), 5t/ha Cow-dung (CD), 5t/ha groundnut residue (GR), 5t/ha maize residue (MR), 120kg/ha (NPK) and no application as control. Supplying was done five days after transplanting to replace the missing stands. PGM, CD, MR and GR were applied a week before transplanting while NPK fertilizer was applied a week after transplanting. Cow-dung manure were the droppings from cattle piled up at the range and left to decompose for about five months on farm while the Pig manures (PGM) were evacuated from the College farm during daily cleaning and deposited outside the ranch. Both maize and groundnut residues were collected from the farm after maize and groundnut harvesting. Data were taken on fruit yield, soil nutrient content and plant uptake. Data analysis was done using Analysis of Variance (ANOVA) while the significant means were separated by Duncan Multiple Range Test (DMRT) at 5% level of significance. The experiment was repeated in the second year on the same plots without fertilizer application in order to assess the residual nutrients.

RESULTS

The nutrient status of the soil was below the critical levels for N, P and K with slight acidity and sandy loam textural class (Table 1). Total nitrogen content of piggery and cow-dung manure (Table 2) were highest (0.003%) while pig manure had the highest values of available P (Av.P) and K (0.015 and 0.057g/kg) respectively. The Cowdung had higher values of P (0.015g/kg). Pig manure should be expected to provide the soil and plant with higher quantity of nutrients than other treatments, because it contains higher N, P and K than CD, MR and GR.

All growth parameters were significantly influenced by the treatments. Tallest plants of (31.63 cm) were recorded from application of NPK followed by PGM (25.94 cm), CD (24.48 cm), GR (19.75cm) and MR (16.47cm), while the shortest plants of (13.47cm) were recorded from the fertilized plants. The tallest plants from NPK fertilized plots may be due to the better response of the NPK fertilizer compared with the farm yard manure (PGM and CD) and crop residues (GR and MR) which will undergo decomposition before nutrient release. Similarly, the better response from farmyard manures (PGM and CD) over crop residues (GR and MR) may be due to differences in their

nutrient compositions. The PGM contains more N, P and K contents than CD while the GR had better N, P and K nutrient contents than MR respectively.

Maximum number of leaves (59.29cm) was recorded from NPK treatment while the minimum number of leaves (9.98cm) was recorded from the control plants (Table 4).

Maximum leaf area (5.39 cm²) was recorded with NPK while the minimum number of leaf area (2.94 cm²) was recorded with control (Table 5). Similarly, the farm yard manures (PGM and CD) gave better leaf area compared with the crop residues (GR and MR). Maximum number of flowers (42.17) was recorded with NPK followed by PGM (34.64), while minimum number of flowers (9.7) was recorded with control (Table 6).

The longest fruits of (8.09cm) were recorded from NPK treatment while the shortest fruits of (5.08cm) were recorded with control (Table 6).

Maximum average fruit weight (24.99 tonnes) were recorded with NPK followed by PGM (19.10 tonnes), while minimum weight of fruits (8.95 tonnes) was recorded with control. From (Table 7) significant ($P > 0.05$) treatments effects were obtained on total number of flowers/plant, fruit length and fruit yield weight after the repeated cultivation of *Capsicum annum* without treatment application. The result followed similar trend when compared with observation from both farmyard manures (PGM and CD) and crop residues (GR and MR) applications respectively. For all the yield characters evaluated, the highest value of residual effect was obtained from plots treated with PGM followed by CD while the control gave the least.

DISCUSSION

The effectiveness of the farm yard manures (PGM and CD) and crop residues to supply plant nutrients in slowly available form was probably due to initial delay in the rate of decomposition and mineralization during the first planting season (Sharma and Mitra, 1991). The result also, corroborated with the work of Ghosh *et al.*, 2003 who viewed that organic manures played an important and significant role in increasing yield of Sorghum and Soybean and had residual effect on succeeding Wheat. While the NPK, on the other hand is most readily available and easily absorbable by the *Capsicum* plant. The performance of NPK fertilizer corroborated with the work of Kareem *et al.*, (2018) who explained that the advantage

of using inorganic fertilizers is that nutrients are immediately made available to plants and exact needed amount of a particular nutrient element can be measured before feeding the plants.

The response of PGM manure over CD application may be due to variation in the nutrient contents. Result also revealed that GR residue is better than MR residue. Thus, the order of response by the treatments $PGM > CD$ and $GR > MR$ ascertained the findings of Bello and Salami, 2018 who concluded that the richer the organic manure, the better the response. Similarly, the findings imply that both sources of manures (farmyard and crop residues) had significant influence on the performance of pepper (*Capsicum annum*). The result is in line with the findings of Bello *et al.*, 2018 who affirmed that among the most promising organically based soil nutrient management practices are the incorporation of crop residues and legume waste.

Maximum number of leaves shown by NPK plot might be due to fact that application of NPK provided adequate Nitrogen which is associated with high photosynthetic activity and vigorous vegetative growth. Similar results were reported by Sree *et al.* (2004), Pariari and Khan (2013). This response may be due to translocation of nutrients to the aerial parts of the plant. NPK was able to supply higher nutrients amounts compared to others. The variations in the nutrient contents of the treatments affected the uptake of NPK and resulted in maximum number of flowers per plant in *Capsicum*. Similar results were obtained by Kumar *et al.* (2013) and Shiva *et al.* (2015). Also, the maximum number of fruit length produced by NPK may be due to more availability of NPK leading to increased uptake of the nutrients compared to other treatments. Similar results were obtained by Pariari and Khan (2013).

The maximum response shown by NPK might be because it is a good source of organic matter and could have improved the physico-chemical properties of soil and thereby resulted in highest leaf area of *Capsicum*. It also indicates that NPK enhances some plant growth promoters such as auxins and gibberellic acid than other. Similar results were reported by Sree *et al.* (2004).

Increase in number of fruits per plant is due to the production of more flowers, higher percentage of fruit set and reduced shedding of flowers and fruits and thus, resulted in increased fruits. Similar result was obtained by Tripathy

and Maity (2011). The response of fruit yield to treatments mainly depends on the NPK content in their composition. The response of the treatments could also be attributed to a higher C/N ratio and increased plant metabolism.

The result clearly indicated that farm yard manures performed remarkably better than crop residues while the PGM plots had the best residual effects. The residual response from the treatments indicated that farmyard manure recycling is one of the main options adopted in agriculture because its compost is rich with plant nutrients especially N and P and are effective long lasting amendments as discovered by Bello *et al.*, 2015.

CONCLUSION

This study confirms that NPK fertilizer, farmyard manures and crop residues are valuable amendments for improving soil fertility and to sustain pepper (*Capsicum annum*) production in the study area. Although the use of NPK fertilizer gave a better response in the first cropping season while the farm yard manures application produced higher pepper yield in the second cropping season.

Thus, the use of farmyard manure gave a better response compared to the crop residues. Hence, the result shows that the manures had a long term residual effects compared with NPK fertilizer in terms of sustainability of the yield and soil fertility restoration. Although, the order of response shown by the treatments is NPK fertilizer with the highest performance in the first cropping season while $PGM > CD$ and $GR > MR$ gave a better residual effect on growth, yield and yield components of pepper *Capsicum annum*.

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