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EFFECT OF INORGANIC FERTILIZERS SUPPLEMENTED WITH FARMYARD ORGANIC MANURES ON SEEDLING GROWTH OF WHEAT (*TRITICUM AESTIVUM* L.) IN PLATE CULTURE

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ABSTRACT

A laboratory experiment was conducted to evaluate the manural potential of farmyard manure (FYM), vis-a-vis 25%, 50% and 100% recommended dose of two standard, commercial rate of NPK fertilizer (i.e 120:60:30) and to find out the most productive cropping system at various strength of chemical fertilizers and organic manures. In the given research the performance of organic fertilizer for compromising with expensive inorganic fertilizer was studied with respect to the growth of wheat (*Triticum aestivum* L.). The policy led to the minimal usage of high quantity fertilizer with the output of quality production.

Experiment comprised fertility level of NPK @120:60:30 along with FYM @ 5t ha^{-1} (aprox. 2.5gm/litre) NH_4NO_3, $CaHPO_4$. $2H_2O$, KCL were used as sources of N, P_2O_5 and K_2O, respectively. In the given research all growth parameters including SL, RL, SFW, SDW, RFW and RDW of wheat was recorded maximum at 25% NPK (1/4th strength). Application of FYM @ 5 t ha^{-1}, at 120:60:30 NPK, to compensate the low strength of NPK was favored at both strength 25% and 50% NPK and produced significantly higher growth in wheat than all other single treatments. It has been realized from experiments that neither chemical fertilizers nor organic manures alone can achieve sustainability in production, whereas the integrated use of organic and inorganic can sustain a highly intensive production system.

Keyword: Inorganic Fertilizer, Farmyard Manure, NPK Ratio.

INTRODUCTION

It is necessary to maintain soil fertility for sustainable production through judicious use of fertilizers (Bobde *et al*.,1998). Although the use of chemical fertilizer and organic fertilizers has its advantages and disadvantages both in the context of nutrient supply, crop growth and environmental quality, the advantages need to be integrated in order to make optimum use of each type of fertilizer and achieve balanced nutrient management for crop growth. The major three elements of inorganic fertilizer are N, P and K. Different plants require different nutrients and different pH levels in soil. So different types of chemical fertilizers has different formulations these chemical fertilizers are usually classified according to the three principal elements, namely Nitrogen (N), Phosphorous (P) & Potassium (K). The NPK fertilizer is formulated in appropriate concentrations and combinations, supply these three main nutrients: N (nitrogen) promotes leaf growth and forms proteins and chlorophyll. P (phosphorus) contributes to root, flower and fruit development and K (potassium) contributes to stem & root growth and Protein synthesis. Adequate P nutrition enhances many aspects of plant physiology, including the fundamental processes of photosynthesis (Yahiya *et al.*, 1995), and its deficiency may reduce crop growth, delayed flowering and maturity (Chauhan *et al.*, 1992), Organic Fertilizers are the most convenient forms of fertilizers. Things like cattle and poultry manure, slurry, worm castings, peat moss, seaweed, sewage and guano are good examples of organic fertilizers. Vegetation material called mulch, such as hay, peat moss, leaves, grass, bark, wood chips, seed hulls, and corn husks all help to aerate the soil, insulate the ground against temperature change, and add needed nutrients. Farmyard manure is the most popular type of organic matter. It consists of animal excrements, both liquid and solid, and of the litter put down for the animals to lie on. FYM is relatively a cheap source of both macro nutrients (N, P, K, Ca, Mg, S) and micronutrients (Cu, Fe, Mn, B) and can increase soil carbon/N content, soil porosity and enhance soil microbial activity.

Due to intensive cropping systems and unbalanced fertilization, there is severe depletion of soil fertility due to continuous removal of nutrients (Gosh *et al.*, 2004a) and reduction in the use of organic manure with grain crop, may lead to the reduced soil fertility and crop productivity in long run (Dong *et al.*, 1998). Among factors responsible for the low yield is low soil fertility. Poor availability of nutrients in soluble form in the arid and semi-arid soils is the most important limiting factor as compared to that of moist areas. In addition high costs of inorganic fertilizers are making it difficult to use them extensively in developing countries. While, organic manures alone cannot supply sufficient P for optimum growth but have certain characteristics that increase the availability of P to the crops, Reddy *et al.* (2002). It has been suggested that organic manure should be used along or in place of chemical fertilizer to avoid long term negative effects of chemical fertilizers on the soil (Parr *et a*l., 1990). Organic matter improve soil structure, aeration, soil moisture-holding capacity, and water infiltration.

To achieve sustainability in high production systems, only the integrated use of organic and inorganic fertilizers can play a vital role (Gosh *et al.*, 2004b). Organic manures added in the soils in combination with inorganic or chemical fertilizers, supplement all nutrients to crop and increase the productivity of crops. Advantages of integrated use of these fertilizers possibly due to increased water holding capacity of FYM that solubilize the soil and fertilizer and stimulation of the synthesis of soil microbial biomass and labile microbial metabolites. Blake *et al.* (2002) also observed significant increase in the P uptake where there was integrated use of organic and inorganic phosphorus forms. Ahmed *et al*. (1998) indicated that wheat yield under rainfed condition could be increased significantly by the combined use of organic and mineral fertilizers. Hati et al. (2001) also find the application of balanced rates of fertilizers in combination with organic manure could sequester soil organic carbon in the surface layer, improve the soil physical environment and sustain higher crop productivity under this intensive cropping system. Similar results were obtained by Mandal and Sinha, (2004) who reported that inorganic fertilizers (NPK) applied along with FYM increased the yield of Indian mustard. Most distinguishable results for the direct and residual effects were obtained where FYM @ 5 t ha-1 was applied along with 75% NPK for wheat and soybean crops (Gosh *et al.*, 2004a). Therefore, Application of the full recommended amount of fertilizer only maintained the N, P and K status in soil. Higher profit was obtained when inorganic fertilizer was combined with organic manures. This integrated nutrient management system is characterized by reduced input of chemical fertilizers and combined use of chemical fertilizers with organic materials. Therefore, a balanced fertilization strategy that combines the use of chemical and organic fertilizer must be developed and evaluated which also decrease the problems associated with conventional NPK chemical fertilizers and thereby protect both the environment and human health and reduce expenses of poor farmer. The present research work was undertaken to study the effect of N, P and K level on the growth of wheat growing under reduced rate of fertilizer (25% and 50%) compromising with FYM as organic fertilizer.

MATERIALS AND METHODS

Plate culture method: In this experiment Petri dish method was used to study the beneficial effect of different doses of standard NPK rate (100%, 50% and 25%), alone and along with FYM extract on the growth parameters of wheat. NH_4NO_3, $CaHPO_4 . 2H_2O$ and KCL were used as sources of N, P_2O_5 and K_2O, respectively. Two sets of treatment were designed and organized on two different NPK ratios 120:60:30 & 100:50:50 along with FYM (i.e.5ton/ha). Ten healthy, chemically sterilized seed of wheat placed in Petri dishes with one disc of filter paper under normal laboratory condition with temperature ranging from 21-25 ^{0}C. Five ml of each treatment were added daily to 3 replicates of each treatment plate. Distilled water was applied to the control. The growth parameters including shoot length, root length, shoot fresh and dry weight and root fresh and dry weight were recorded after 6th day of germination. The percentage of inhibitory effect on shoot and root growth (length, fresh weight, dry weight) in comparison to control was calculated as by Surendra and Pota, (1978): I = 100-T/C x 100 Where, 'I' is the parentage of inhibition 'T' is treatment reading and 'C' is control plant reading.

Data Analysis: The data of all the above mentioned parameters were individually subjected to the analysis of standard deviation statistically to evaluate the treatment effect through Duncan's multiple range test (DMRT).

Experimental Set Up:
NPK (120:60:30)
Treatments
T0= Control
T1= NPK 100% (Full Strength)
T2= NPK 50% (1/2 Strength)
T3= NPK 25% (1/4 Strength)
T4= NPK 50% +FYM
T5= NPK 25%+FYM

RESULT

It is evident in Table-1 that, ¼ strength (25%) of NPK 120:60:30 caused significant increased in SL, RL, SFW, SDW, RFW and RDW of wheat plant over control. The relative percentage of increment of Shoot length and Root length over control plant reached +7.90 % and +37.8% and Shoot fresh and Dry weight reached to +3.22% , +14.28% +17.6% +13.4% due to low concentration of inorganic salt that reduced osmotic gradient and increase nutrient uptake from soil. Addition of FYM @ 5 t ha^{-1}, at 120:60:30 NPK, to compensate the low strength of NPK was favored at both strength 25% and 50% NPK and produced significantly higher growth in black gram than all other single treatments.

Shoot length (cm): Table 1 showed that The SL was higher at 25 % strength (+7.9 % over control) then 50% half strength (+0.19 %) & the substitution of NPK with FYM was supportive for both strength to increase shoot length up to +14.6 % at 50 % strength and +21.7 % at 25 % over control.

Root Length (cm): Table 1 showed that 25% strength was again useful for root length & gave approximately the same result (i.e +37.8%) as full strength (i.e. +39.1 %). Addition of FYM & as NPK substitute was also beneficial for both strength to enhance RL from +22.4 % to +47.2 % at ½ strength & +37.8% to +50% at ¼ strength.

Table 1. Effect of different NPK treatments (alone or along with FYM) on Wheat in Plate culture.

TREATMENT		Shoot Length (cm)	Root length (cm)	Shoot fr. wt (g)	Root fr.wt (g)	Shoot dry wt. (g)	Root dry wt. (g)
T0	Control	5.06 f (0)	7.4 f (0)	0.31 c (0)	0.33 d (0)	0.028 e (0)	0.05 b (0)
T1	100% NPK	5.63 c (+11.2)	10.3 c (+39.1)	0.301 d (+2.9)	0.393 c (+17.66)	0.026 f (-7.14)	0.1 f (+100)
T2	50% NPK	5.07 e (+0.19)	9.06 e (+22.4)	0.27 f (-12.9)	0.317 e (-5.09)	0.03 d (+7.14)	0.02 e (-60)
T3	25% NPK	5.46 d (+7.90)	10.2 d (+37.8)	0.32 b (+3.22)	0.139 f (-58.38)	0.032 c (+14.28)	0.028 d (-44)
T4	50% NPK + FYM	5.8 b (+14.6)	10.9 b (+47.2)	0.30 e (-3.2)	0.445 b (+33.23)	0.11 a (+450)	0.03 c (-40)
T5	25% NPK + FYM	6.16 a (+21.7)	11.1 a (+50)	0.35 a (+12.9)	0.58 a (+73.65)	0.034 b (+21.42)	0.068 a (+36)

Value in parenthesis indicate percent increase (+) or decrease (-) over control.
Means followed by different letter shows significant result at the level of Standard deviation.

Shoot Fresh Weight (g): Table 1 showed that 25 % strength again supported SFW more than half & full strength & gave +3.22% increases over control. This result was improved by adding FYM along with this low rate of NPK up to +12.9% over control.

Shoot Dry Weight (g): Table 1 showed that SDW was slightly higher at 25% strength (i.e +14.28%) than half strength (i.e + 7.14%) & full strength. And the addition of FYM to compensate the reduce rate of NPK was also useful to increase shoot dry biomass from +14.28% to +21.42% at 25% and +71.4% to +450% at 50% due to more availability of nutrient at this treatment (i.e 50% NPK+FYM).

Root Fresh Weight (g): Table 1 showed that Half strength of NPK (120:60:30) rate was more supportive for root fresh weight than 25% strength, Here 25% strength had inhibitory effect i.e – 58.38%. For this growth parameter the addition of FYM was useful to remove the inhibitory effect of 25% strength & increased the value from –58.38%. to +73.65% at 25% strength. It also reduces the negative effect of 50% strength from – 5.09% to +33.23%.

Root Dry Weight (g): Table 1 showed that 25% of NPK strength had more promotive effect on RDW than 50%. (i.e +7.145 at half strength NPK and +14.28% at i/4 strength NPK). More over it also increased the RDW when 25% NPK was substituted with FYM (i.e +36% over control).

DISCUSSION

All growth parameters including shoot length, root length, shoot fresh and dry weight, and root fresh and dry weight of wheat was recorded to be maximum at 25% NPK (1/4th strength). Application of FYM @ 5 t ha^{-1}, to compensate the low strength of NPK was favored at both strength 25% and 50% NPK and produced significantly higher growth in wheat than any other single treatments. Similar findings were also reported by Tiwari & Parihar (1992), Ramesh *et al*., (1999), Gorttappeh *et al*., (2000), Saeed *et al*., (2002), who stated that organic manure alone or in combination with synthetic fertilizers significantly increased the yield against control. Beneficial effect of combined use of organics and inorganics in increasing crop yields as well as maintaining soil health on long-term basis had also been reported by Mishra et al. (1990).

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