ISSN:0971-1260
Vol-22-Issue-34-December -2019

Effect of chemical and organic fertilizers on growth and yield of wheat

Pawanpreet Kaur and Bhupendra Mathpal
School of Agriculture, Lovely Professional University, Phagwara, Punjab, India, 144410
Corresponding author:mathpal.88@gmail.com

Abstract

Four wheat varieties viz., PBW725, HD3086, HD2967 and PBW677 were examined for their performance under various forms of fertilizers. Treatments were control (no fertilizer application), recommended dose of chemical fertilizers (nitrogen, phosphorus and potassium), recommended dose of farm yard manure (FYM) and chemical fertilizers (half of recommended dose) + farm yard manure (half of recommended dose). Plant height and number of tillers were recorded at 60 days after sowing whereas grain yield and straw yield was recorded after the harvesting of crop at maturity. Among all the fertilizers tested combined application of chemical and farm yard manure was found most effective in increasing all the parameters recorded. A comparison was also made among all varieties and variety HD3086 showed maximum plant height and straw weight while maximum tillers and grain yield was recorded in variety PBW725.
Keywords: Wheat, chemical fertilizers, FYM, growth and yield.

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Introduction

Soil is a "silent partner" for the farmer. It supplies water and essential nutrients to plants, physically strengthen plants, help in management of pests, regulate the rainfall, protect the air, wildlife and drinking water quality. There are three soil properties as most important with regard to any plant response-related functions, these are; soil pH (to regulate nutrient availability), texture (to regulate water transmission properties and fixation and release of nutrients) and organic matter (to realize the cascading effect on whole range of soil physical as well chemical properties, including the biological properties), and above all, plant traits as well (nutrient capability and nutrient) responsive both.

The fertilizers are used inclusively in inappropriate manner: more fertilization causes environmental pollution in many countries like India, China, Western Europe, North America, even as under utilization it causes soil mining in parts of Latin America, Africa and Eurasia. It has been observed that in China, there is more fertilization of N that occurs in the order of 11.8 Mt, if it is used on 174 million ha of productive land in sub-Saharan Africa it could potentially double yields (Ju et al., 2009). The diagnostic tools of soil and plants, like quick assessment kits and mobile spectrometers, should be recommended to soil type that turn into an important part of fine tuning fertilizer and used for aiming the appropriate fertilizer kind to their productive system and regions as channel to producers, traders and users (Shepherd and Walsh, 2007).

The response of crops to nutrient elements varies according to soil properties. For example, the pH of a soil can decide the amount of nutrient available to plants (Marschner, 2012). As the situation could confused due to change in pH of soil induced by a fertilizer treatment, The few of urea-micronutrient mixed fertilizers have alkaline nature that could delay nutrients accessibility, as reported for zinc (Zn) (Milani et al., 2012). Due to proton release, NH_4^+-based fertilizers would acidify the soil, thus affects P availability. However, N containing fertilizers would be appropriate for alkaline soils that acidify the rhizosphere where micronutrients availability are in adequate.

A wide variety of practices have been used to apply the four principles, including coating of fertilizers, deep placement, precision application and row application to reduce nutrient losses (Chien et al., 2009). Regrettably, to address the flaws of current fertilizers, the overall development or progress achieved by these practices and programmers has been unsatisfactory.

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Yet, for several decades the fertilizer research has mostly been ignored. The major factor of INM is balanced application of proper fertilizers. Based on agroclimatic considerations and crop requirements, fertilizers are have to be applied at stage desirable for best growth of crop. On the similar time, harmful externalities should be minimized. Over application of fertilizers is cheap for few farmers that encourage neither significant higher yields nor substantial greater crop nutrient application (Smaling and Braun, 1996).

Material and methods

A pot experiment was carried out at Research farm of Lovely Professional University, Phagwara, Punjab, India. The soil used for experiment was classified as sandy loam and was low in phosphorus (P) (21 kg/ha), organic carbon (C) (0.3%) and deficient in the zinc (Zn). Available potash content of the soil was medium. The pots of 5 kg capacity were used to conduct experiment and 4 kg of soil was filled in each pot. Soil was well grinded into fine particles before filling into the pots. Water was applied in all the pots after the filling of soil so that soil can properly settle down. Water was allowed to stand overnight. Next morning sowing of seeds was done. Varieties PBW725, HD3086, HD2967 and PBW677 were used as planting material. In each pot three seeds were sown to maintain uniformity.

Recommended dose of chemical fertilizers and farm yard manures were applied at the time of pot filling. Pots were irrigated immediately after fertilizers application and left overnight to saturate. The experiment was laid out in factorial completely randomized design with 3 replications. The data was analyzed statistically at $P \leq 0.05$ using SPSS software.

Parameters recorded:

Plant height (cm)

Plant height was measured after 60 days of sowing. Measuring tape was used to measure the height of plant from the ground surface to the flag leaf of plant and expressed in centimeters (cm).

Number of tillers

Numbers of tillers were counted 60 days after the sowing and expressed on per plant basis.

Number of leaves plant^{-1}

Numbers of leaves were counted 60 days after sowing and expressed on per plant basis.

Grain yield (g)

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Crop was harvested at maturity and grains were separated from straw part to measure grain yield. Grain yield was recorded on per pot basis and expressed in grams (g).

Straw yield (g)

After harvesting the crop straw part from each pot was collected and allowed to dry under sunlight. The weight was recorded and expressed in grams (g).

Results

Plant height

Plant height measured at 60 days after sowing is presented in table 1. There was an increment reported in plant height along with fertilizers type. All four varieties responded significantly under various types of fertilizers. On comparing all the fertilizers, application of chemical fertilizers (NPK) in combination and farm yard manure (FYM) showed significant increment in plant height. A percent increment of 37.96%, 57.46% and 78.03% was found by the application of NPK, FYM and a combined application of both respectively in comparison to control. While comparing plant height of all four varieties HD3086 showed maximum plant height followed by PBW725, HD2967 and PBW677.

Table 1. Effects of NPK and farm yard manure on the plant height (cm) in wheat.

Treatments	Varieties				
	PBW725	HD3086	HD2967	PBW677	Average
Control	17.53d ±0.34	24.30^{d} ±0.10	23.56^{d} ±0.29	22.56^{d} ±0.29	21.98
NPK	25.30^{c} ±0.61	33.46^{c} ±0.46	31.23^{c} ±0.54	31.13^{c} ±0.39	30.28
FYM	31.46^{b} ±0.42	36.53^{b} ±0.37	33.60^{b} ±1.08	36.86^{b} ±0.37	34.61
NPK+FYM	33.83^{b} ±1.01	43.16^{a} ±0.17	38.13^{a} ±0.29	41.43^{a} ±0.72	39.13
Average	27.03	34.36	31.63	32.99	

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at $p<0.05$ for separation of means).

Number of tillers

Number of tillers per plant under various fertilizers is presented in table 2. Application of both NPK+FYM resulted in maximum number of tillers in all the varieties and the percent increment was 100% in comparison to control. This trend of percent increment by 55.15% and 24.51% was followed by application of FYM and NPK, respectively over control. Among all the

ISSN:0971-1260
Vol-22-Issue-34-December -2019

varieties examined in experiment PBW677 produced maximum number of tillers followed by HD3086 while varieties PBW725 and HD2967 showed equal number of tillers.

Table 2. Effects of NPK and farm yard manure on the number in tillers plant-1 of wheat.

Treatments	Varieties				
	PBW725	HD3086	HD2967	PBW677	Average
Control	3.66^{c} ±0.33	3.66^{c} ±0.33	4.00^{a} ±1.15	5.00^{c} ±0.01	4.08
NPK	5.00^{b} ±0.57	5.66^{b} ±0.66	3.33^{a} ±0.33	6.33^{b} ±0.33	5.08
FYM	5.66^{ab} ±0.33	6.33^{b} ±0.33	6.33^{a} ±1.20	7.00^{b} ±0.57	6.33
NPK+FYM	6.66^{a} ±0.33	10.33^{a} ±0.33	7.33^{a} ±1.20	8.33^{a} ±0.33	8.16
Average	5.24	6.49	5.24	6.66	

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at $p<0.05$ for separation of means).

Table 3. Effects of NPK and farm yard manure on the grain weight (g) in wheat.

Treatments	Varieties				
	PBW725	HD3086	HD2967	PBW677	Average
Control	4.88^{c} ±0.86	8.69^{d} ±0.20	9.76^{c} ±0.67	8.38^{d} ±0.30	7.92
NPK	7.99^{b} ±0.51	11.37^{c} ±0.66	11.98^{bc} ±0.83	12.48^{c} ±0.68	10.95
FYM	9.97^{b} ±0.86	13.87^{b} ±0.19	13.42^{b} ±0.56	15.62^{b} ±0.38	13.22
NPK+FYM	20.64^{a} ±0.56	24.07^{a} ±0.49	18.79^{a} ±0.49	22.07^{a} ±0.33	21.39
Average	10.87	14.5	13.48	14.63	

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at $p<0.05$ for separation of means).

Grain weight

The grain weight of all wheat varieties under various fertilizers is presented in table 3. Regarding effect of fertilizers on grain weight, application of NPK+ FYM was found most effective in increasing mean grain yield of all varieties and the percent increment was 170.08% as compared to without fertilizer application. A percent increment of 38.26% and 66.92% was

ISSN:0971-1260
Vol-22-Issue-34-December -2019

recorded by the application of NPK and FYM respectively, over control. Variety PBW677 responded well and produced maximum grain yield among all varieties tested.

Straw weight

The straw weight of the wheat significantly influenced all the fertilizers applied in study (table 4). Maximum straw weight was produced under the combined application of NPK+FYM followed by use of NPK and FYM individually. The percent increment was 241.01% by NPK+FYM application, 90.92% and 152.2% by individual application of NPK and FYM respectively. The variety HD3086 produced maximum straw weight followed by HD2967, PBW677 and PBW725.

Table 4. Effects of NPK and farm yard manure on the straw weight (g) in wheat.

Treatments	Varieties				
	PBW725	HD3086	HD2967	PBW677	Average
Control	6.34^{d} ±0.38	13.01^{d} ±0.54	14.11^{d} ±0.41	8.39^{d} ±0.22	10.46
NPK	12.19^{c} ±0.38	22.40^{c} ±0.76	23.94^{c} ±0.55	21.36^{c} ±0.48	19.97
FYM	21.37^{b} ±0.70	28.05^{b} ±0.65	28.21^{b} ±0.30	27.89^{b} ±0.46	26.38
NPK+FYM	25.77^{a} ±0.41	48.04^{a} ±0.43	36.14^{a} ±0.51	32.73^{a} ±0.56	35.67
Average	16.41	27.87	25.60	22.59	

(According to DMRT (Duncan's multiple range tests), the data followed by various letters are significantly at $p<0.05$ for separation of means).

Discussion

It has clearly observed from the results that plant height significantly increased by the combined application of both NPK and FYM. It might be due to the improved soil structure and texture by the application of FYM which improved absorption of nutrients and resulted in increased plant height. Results of present study finds support of El-Ghamri et al., (2009) who also reported increased plant height by integrated use of NPK + FYM. Similarly Abbas et al., 2012 also reported that application of organic manures and chemical fertilizers was most effective in increasing plant height of wheat.

Data pertaining to number of tillers per plant clearly indicated that integrated use of NPK and FYM was found to be most effective in enhancing tillers number in all wheat varieties. This

ISSN:0971-1260
Vol-22-Issue-34-December -2019

treatment provides better chance to crop for better growth especially in vegetative growth stage (Chhogyel et al., 2015). According to the results of Kulkarni et al., 2018 use of recommended dose of fertilizers along with FYM resulted in increased number of effective tillers in wheat.

The wheat grain yield was significant because of the combined use of poultry manures, compost, cow dung and NPKS fertilizers. The varieties treated with poultry manure gave maximum grain with same recommended fertilizer doses as fertilizers and manures influence wheat grain yield as compare to cow dung and treated plots of compost (Abbas et al., 2012). The nutrients were discharged hastily by the occurrence of uric acids in poultry manure rather than cow dung and compost. Also, initiate increased yield of grain with the combined application of fertilizers and manures (Haque et al., 2001, Asit et al., 2007) and (Bodruzzaman *et al*., 2010).

By the collective use of fertilizers and manures the yield of wheat straw also responded significantly. It was also observed the yield of wheat straw increased by collective appliance of organic manure with fertilizers, considerably (Akhtar et al., 2005). Application of 100% NPK showed not best results as compare to 50% NPK and 50% organic matter to increase the straw weight (Kumar and Yadav., 1993).

Conclusion

Results of present study clearly indicated that integrated use of chemical fertilizers (NPK) and FYM increased the grain yield of wheat crop. Therefore, it can be concluded that application of both the types of fertilizers (chemical + organic) would be helpful to maintain soil health and improve yield of crops.

References

Abbas, G., Khattak, J. Z. K., Mir, A., Ishaque, M., Hussain, M., Wahedi, H. M., & Ullah, A. (2012). Effect of organic manures with recommended dose of NPK on the performance of wheat (Triticum aestivum L.). *Journal of Animal and Plant Sciences, 22*(3), 683-687.

Akhtar, M., McCallister, D. L., Francis, D. D., & Schepers, J. S. (2005). Manure source effects on soil phosphorus fractions and their distribution. *Soil Science, 170*(3), 183-190.

Bodruzzaman, M., Meisner, C. A., Sadat, M. A., & Hossain, M. I. (2010, August). Long-term effects of applied organic manures and inorganic fertilizers on yield and soil fertility in a wheat-rice cropping pattern. In *Proceedings of the 19th World Congress of Soil Science, Brisbane, Australia* (pp. 142-145).

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Chhogyel, N., Zamora, O. B., Espiritu, B. M., & Bajgai, Y. (2015). Effects of organic and inorganic fertilization on rice crop performance, soil animal population and microbial diversity in organic and conventional soils. *Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences*, *31*(2), 159-170.

Chien, S. H., Prochnow, L. I., & Cantarella, A. H. (2009). Recent developments of fertilizer production and use to improve nutrient efficiency and minimize environmental impacts. *Advances in Agronomy*, *102*, 267-322.

El-Ghamry, A. M., El-Hamid, A. A., & Mosa, A. A. (2009). Effect of farmyard manure and foliar application of micronutrients on yield characteristics of wheat grown on salt affected soil. *American-Eurasian Journal of Agricultural & Environmental Sciences*, *5*(4), 460-465.

Haque, R., & Freed, V. H. (Eds.). (1975). *Environmental dynamics of pesticides* (pp. 97-114). New York: Plenum Press.

Ju, X. T., Xing, G. X., Chen, X. P., Zhang, S. L., Zhang, L. J., Liu, X. J., ... & Zhang, F. S. (2009). Reducing environmental risk by improving N management in intensive Chinese agricultural systems. *Proceedings of the National Academy of Sciences*, *106*(9), 3041-3046.

Kulkarni, M. V., Patel, K. C., & Patil, D. D. (2018). Effect of organic and inorganic fertilizers on yield and yield attributes of groundnut and wheat. *International Journal of Chemical Studies*, *6*(2), 87-90.

Kumar, A., & Yadav, D. S. (1993). Effect of long-term fertilization on soil fertility and yield under rice-wheat cropping system. *Journal of the Indian Society of Soil Science*, *41*(1), 178-180.

Marschner, H. (2012). Marschner's mineral nutrition of higher plants. Vol. 89.

Milani, N., McLaughlin, M. J., Stacey, S. P., Kirby, J. K., Hettiarachchi, G. M., Beak, D. G., & Cornelis, G. (2012). Dissolution kinetics of macronutrient fertilizers coated with manufactured zinc oxide nanoparticles. *Journal of agricultural and food chemistry*, *60*(16), 3991-3998.

Smaling, E. M., & Braun, A. R. (1996). Soil fertility research in sub-Saharan Africa: New dimensions, new challenges. *Communications in Soil Science and Plant Analysis*, *27*(3-4), 365-386.