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Effect of organic and inorganic source of nutrients on growth and yield of barley (*Hordeum vulgare* L.)

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Abstract
A field experiment was conducted to study the "Effect of organic and inorganic source of nutrients on growth and yield of barley (*Hordeum vulgare* L.)" at the Research Farm of Department of Soil Science, SHUATS, Allahabad. The experimental field was applied with different levels of NPK (NPK-0%, NPK-50% and NPK-100%) and FYM (FYM 0 tha^{-1}, FYM 5 tha^{-1} and FYM 10 tha^{-1}). The experimental results revealed that both NPK and FYM nutrients alone or in combination had significant effect on growth parameters (plant height, number of tillers, number of spikes, spikes length) and yield parameters (grain yield and biological yield) of barley. The best treatment for maximum growth parameters (plant height, number of tillers, number of spikes, spikes length) and yield parameters (grain yield and biological yield) was noted in treatments applied with combination of both high concentration of NPK and FYM. From the results it was indicated that NPK should be used with FYM in order to have good biomass and maximum yield of barley.

Keywords: NPK, FYM, growth parameters, yield, barley

Introduction
Barley (*Hordeum vulgare* L.), belonging to Poaceae family, is one of the most important staple food crops in the world. It is the world's fourth most important cereal after wheat, rice and maize (Mohammad *et al.*, 2011; Chavarekar *et al.*, 2013); Tarun *et al*. 2013) [9, 4, 14]. It ranks fifth among cropping rain production in the world after maize, wheat, rice and soybean (Miralles *et al.*, 2001; Zeid, 2011; Soleymani and Shahrajabian, 2011) [8, 17, 12]. Barley ranks next to wheat both in acreage and production among *Rabi* cereals in India (Tarun *et al.* 2013) [14]. Organic manuring and nitrogen fertilization are considered among the most important cultural practices for increasing barley productivity and improved quality parameters. In crop production, nutrient availability from manure has been recognized for many centuries (Chavarekar *et al.*, 2013) [4]. Modern agriculture, which largely depends on chemical fertilizers, pesticides, herbicides etc., though increased production, has adversely affected the soil productivity and environmental quality. During the era of green revolution, spectacular increase in crop yields resulted in primarily from the introduction of the fertilizers responsive high yielding varieties, use of high quantity of chemical fertilizers and pesticides. The heavy use of chemical fertilizers, pesticides and fungicides caused health hazards and environmental pollution apart from imparting resistance to the causal agents against chemical pesticides and fungicides (Vasant *et al.*, 2012) [16]. Nutrients are essential for crop production, all plants require nutrients to grow and a significant portion of these nutrients are removed and exported when a crop is harvested. Sustainable crop production requires then nutrients that are removed to be replaced with synthetic fertilizers, manures, municipal wastes or, in a few cases, the atmosphere (Manitoba, 2013) [7]. The use of chemical fertilizers is essential for obtaining high yields (Abay and Tesfaye 2012) [1]. However, many small holder and resource poor farmers do nothing access to synthetic fertilizer because of its high price, lack of credit facilities, poor distribution, and other socio-economic factors. Consequently, crop yields are low, in fact decreasing in many areas, and the sustainability of the current farming systemisatrisk (Stangel, 1995; UNDP, 1992) [13, 15]. The large scale grain production through application of chemical fertilizers is base of green revolution (Ashwini *et al.*, 2014) [2]. However, injudicious use of fertilizers adversely affects the productivity of crop and properties of soil. The chemical fertilizers no doubt are important sources which can meet then nutrient requirement but their imbalanced and continuous use lead to deterioration of physico-chemical properties (Raghuwanshi *et al.*, 1988) [10]. The combined use of organic and inorganic fertilizers not only increases the crop yield but also improve the physical and biological properties of soil (Shashidhar *et al.*, 1995) [11].

Soil nutrient status is widely constrained by the limited use of inorganic and organic fertilizers and by nutrient loss mainly due to erosion and leaching (Balesh *et al.,* 2007) [3].Minerals fertilizers have a significant importance in crop production and are indispensable component of today's agriculture, but recovery of N to soil plant system is seldomexceeds50%,whereas remainingislost through different means like leaching, volatilization, denitrification etc. Complementary use of organic manures and mineral fertilizers has been proved to be a sound soil fertility management strategy in many countries of the world (Lombin *et al.,* 1991) [6].

Materials and Methods

The field experiment was conducted in 2015 and 2016 during Rabi season to study the "Effect of organic and inorganic source of nutrients on growth and yield of barley (*Hordeum vulgare* L.)" under the agro-climatic conditions of Allahabad at the Research Farm of Department of Soil Science and Agricultural chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences.

Experimental Design

The field experiment was layout in a 3x3 factorial randomized block design with 9 treatment combination, each treatment replicated three times. The factors were located randomly.

Land preparation

The experimental field was prepared by plough twice with a tractor drawn disc plough followed by cross harrowing after pre irrigation to give the soil sufficient moisture required for the germination of the crop. The field thoroughly leveled by a leveler. The ploughed field leveled and weeds, grasses were removed with the help of rake, and then demarcations were done according to the layout.

Application of Fertilizer

The required quantity of fertilizers was applied according to the recommended dose as given in the plan of layout. The fertilizers were applied according to treatment combination. Half entire dose of Nitrogen and total doses of Phosphorus and Potash were applied as basal dressing before sowing and transplanting and mixed in soil with rakes. The rest of the nitrogen was applied as top dressing at 40 & 60 DAS. The fertilizers were given in the form of Urea, SSP and Murate of Potash. The amount of fertilizer required for each plot will be weigh separately and broadcast 9 days after irrigation.

Well decomposed farm yard manure from the A.H. Department was used as organic source of nutrients. Well decomposed FYM on an average contains 0.50% Nitrogen, 0.20% Phosphorus and 0.50% Potassium.

Observations recorded

The observations were taken at different intervals of time. The height of the main shoot of each of three tagged plants was record from ground level to the tip of the main shoots. The average height was calculated for each plant. The tillers were counted randomly from three rows in one plot and the average of three was obtained. Number of spike was counted separately which was obtained randomly from five tagged plants and their averages were recorded. Spike length was measured separately which was obtained randomly from five tagged plants and their averages was recorded. The crop of one square meter area from the center of each plot was harvested and collected separately on the threshing floor. Threshing was done manually and the grains obtained were weighed plot-wise. The amount obtaining in kilograms from the net area converted into qha^{-1}.

Results and Discussion

The results of the experiment presented in table below showed that the effect of organic and inorganic source of nutrients significantly affect the growth and yield of barley. The data revealed that the maximum plant height (101.454 cm), number of tillers (7.853), number of spikes (5.453), spikes length (16.341), grain yield (37.110 qha^{-1}) and biological yield (89.675 qha^{-1})with respect to NPK alone was found in NPK-100% and minimum 88.723 cm, 6.014, 4.027, 13.693, 26.014 qha^{-1} and 65.766 qha^{-1} respectively were found in NPK- 0%. The data also suggested that in case of FYM alone, the maximum plant height (98.017 cm), number of tillers (7.470), number of spikes (5.210), spikes length (16.017), grain yield (34.552 qha^{-1}) and biological yield (82.801 qha^{-1})was found in FYM-10 t $ha^{-1}$and minimum 92.011 cm, 6.472, 4.350, 14.235, 28.385 qha^{-1} and 71.168 qha^{-1} respectively were found in FYM-0 t ha^{-1} but in case of interaction effect of both NPK and FYM, it was observed that the maximum plant height (103.896cm), number of tillers (8.440), number of spikes (6.003), spikes length (17.573), grain yield (41.436 qha^{-1}) and biological yield (97.540 qha^{-1}) was found in T_9 (NPK 100% + FYM 10t/ha) and minimum 85.823 cm, 5.573, 3.706, 12.343, 23.190 and 60.880 respectively were recorded in T_1 (NPK 0% + FYM0 t/ha). The data clearly revealed that both increasing concentration of NPK and FYM nutrients increased the growth and yield of barley. From the study it was also clear that the NPK in combination with FYM nutrients resulted in maximum biomass and yield because FYM contains sufficient amount of N, P, K, S and other nutrients. As nitrogen promotes vegetative growth through cell elongation, Phosphorus is an important element for various metabolic activities and plant growth, K is involved in meristematic growth, regulates translocation of photosynthesis and action of several enzymes and Sulphur is involved in activation of enzyme, which aid in biochemical reactions within plant. It brings significant increase in growth and yield of plant. (Getachew 2009) [5] also reported that the use of organic manures in combination with mineral fertilizers maximized the plan height than the application of inorganic fertilizers alone. Similar findings were also reported by (Abay andTesfaye 2012) [1] that the significant increase were recorded in the number of productive tillers m^{-2}, number of grains $spike^{-1}$and grain weight, above ground dry biomass and grain yield of barley with the combined application of organic and inorganic fertilizers than the application of inorganic NPK alone.

Table 1: Effect of organic and inorganic source of nutrients on growth and yield of barley (*Hordeum vulgare* L.)

Treatment combination	Plant Height	No. of Tillers	No. of Spikes	Spikes length	Grain yield qha^{-1}	Biological yield
T_1	85.823	5.573	3.706	12.343	23.190	60.880
T_2	89.173	6.143	4.096	14.040	26.176	65.943
T_3	91.173	6.326	4.280	14.696	28.676	70.476
T_4	92.023	6.526	4.333	14.893	28.796	70.640
T_5	97.530	7.386	5.140	15.296	31.970	76.706
T_6	98.983	7.643	5.346	15.783	33.543	80.386
T_7	98.186	7.316	5.010	15.470	33.170	81.986
T_8	102.280	7.803	5.346	15.980	36.723	89.500
T_9	103.896	8.440	6.003	17.573	41.436	97.540
CD (P=0.01)	1.978	0.278	0.352	0.488	0.815	1.112
	1.978	0.278	0.352	0.488	0.815	1.112
	3.427	0.082	0.624	0.838	1.403	1.931

T_1= NPK 0% + 0 Tonnes FYM, T_2= NPK 0% + 5.00 Tonnes FYM, T_3= NPK 0% + 10.00 Tonnes FYM, T_4= NPK 50% + 0 Tonnes FYM, T_5= NPK 50% + 5.00 Tonnes FYM, T_6= NPK 50% + 10.00 Tonnes FYM, T_7= NPK 100% + 0 Tonnes FYM, T_8= NPK 100% + 5.00 Tonnes FYM, T_9= NPK 100% + 10.00 Tonnes FYM.

Conclusion

NPK alone was better than FYM in enhancing the biomass and yield. From the study it was concluded that all the growth and yield parameters were recorded maximum in treatment combination of both NPK and FYM. From the study it was clear that NPK should be used with FYM nutrients in order to have good biomass and maximum yield of plant.

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