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Effect of integrated nutrient management on growth, yield and nutrient uptake in maize under rainfed Shivalik foot hills of Jammu region

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Abstract
A field experiment was conducted under rainfed condition during *kharif* seasons of 2014-2017 at the research farm of Advanced Centre for Rainfed Agriculture (Rakh Dhiansar) of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir (UT) to study the effect of integrated nutrient management practices on the growth, yield and nutrient uptake in rainfed maize. Results reveal that the growth parameters of maize crop such as plant height (cm) and dry matter accumulation (q ha^{-1}) were significantly influenced by different integrated nutrients management treatments. Among the integrated nutrient management treatments, highest plant height (199.1 cm) and dry matter accumulation (72.8 q ha^{-1}) were recorded with application of 50% RFD + 50% N (FYM) followed by 50% RFD + 50% N (crop residues) and 100% RFD + $ZnSO_4$ 20 kg ha^{-1}. Among the integrated nutrient management treatments, highest cob length (16.9 cm), cob girth (14.1 cm), stem girth (6.3 cm), grains cob^{-1} (308.9) and 100 seed weight (20.6 g) were recorded with application of 50% RFD + 50% N (FYM) followed by 50% RFD + 50% N (crop residues) and 100% RFD + $ZnSO_4$ 20 kg ha^{-1}. Significantly higher grain yield (1759 kg ha^{-1}) was recorded in 50% RFD + 50% N (FYM) over all the other integrated nutrient management treatments except for 50% RFD + 50% N (crop residues). However, significantly higher straw yield (4049 kg ha^{-1}) was recorded in 50% RFD + 50% N (FYM) over all the integrated nutrient management treatments. Significantly higher total uptake of N, P and K by maize was observed in the treatment comprising of 50% RFD + 50% N (FYM) over all the other integrated nutrient management treatments.

Keywords: Integrated nutrient management, growth, yield, maize and nutrient uptake

Introduction
Maize (*Zea mays* L.) is the third most important food grain crop in India and considered as a most important option for diversifying agriculture in rainfed areas. Maize has high production potential compared to any other cereal crop and it could be well grown under rainfed areas especially when the crops often face moisture stress conditions due to occurrence of mid-season or terminal drought. In India, the area, production and productivity of maize is 9.86 mha 26.26 m tonnes, and 26.64 q ha^{-1} (Anonymous, 2017) [1]. About 12% of the total geographical area of Jammu region constitutes rainfed foot hills mainly encompassing submontane tract locally known as *kandi*. In Jammu and Kashmir (UT) maize crop is grown on an area of about 0.30 mha with a production of 0.49 m tonnes and an average productivity of 16.32 q ha^{-1}. Maize is usually practised by marginal and small farmers of *kandi* belt both under plain and hilly tract of low altitude sub-tropical Jammu region (Singh *et al.*, 2020) [9]. Majority of the rainfed soils are known for their low fertility status as being prone to varying degrees of soil erosion hazards which results in nutrient mining in these soils. Further, imbalanced and disproportionate use of chemical fertilizers in these soils greatly affects the crop productivity. Thus, the crop productivity in rainfed soils could be improved by ensuring adequate supply of nutrients.

Maize being an exhaustive crop has very high nutrient demand and its productivity mainly depend upon the nutrient management system. Continuous use of chemical fertilizers in an imbalanced proportion has witnessed its adverse effects on soil health and also on crop yields. But, the use of organic sources of nutrients alone does not result in spectacular increase in crop yield, due to their low nutrient status. Sustainable yield of maize could be achieved only by applying an appropriate combination of inorganic and organic fertilizers. Maize growers in *Kandi* region generally apply imbalanced chemical fertilizers leading to nutrient

deficiencies of nutrients that further lead to declined organic carbon level in soils (Jamwal, 2000) [4]. Therefore, application of chemical fertilizers alone may not keep pace with time in maintaining soil fertility for sustaining higher productivity and hence, adequate and balanced use of manures and fertilizers is essential for better soil health (Singh *et al.*, 2018) [8]. Application of inorganic fertilizers with different sources of organic manures in different proportions has significant role to boost crop growth and productivity by improving nutrient uptake besides maintaining soil nutrient status in rainfed ecosystems. The availability of nitrogen and other nutrients in the soil has been known to be prime factor in determining the yield. Organic sources like farm yard manure (FYM) and crop residues besides containing nitrogen have capacity to supply macro and other micronutrients considered to be essential for plant growth. As over or under substitution of nutrients through FYM and crop residues in inefficient ways continued, the productivity levels of maize in Shivalik foot hills cannot be increased and sustained (Abrol *et al*., 2007) [2]. Thus, integration of organic and inorganic sources of nutrients seems to be imperative for achieving sustained productivity of rainfed maize. Since, the information on this aspect is lacking, the present investigation was undertaken to evaluate the effect of different integrated nutrient management options on growth, yield and nutrient uptake in maize under rainfed Shivalik foot hills of Jammu region.

Materials and Methods

A field experiment was conducted under rainfed condition at the research farm of Advanced Centre for Rainfed Agriculture (Rakh Dhiansar) of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir (UT) situated at 32^0 39'' N latitude and 74^0 53'' E longitude at an elevation of 332m AMSL during *kharif* seasons of 2014-2017. The soil of experimental site was sandy loam in texture, with a pH of 6.5, low in organic carbon (0.18) and available nitrogen (178 kg ha^{-1}) and medium in available phosphorus (18 kg ha^{-1}) and potassium (108 kg ha^{-1}). The climate of the region is humid sub-tropical with a mean annual rainfall of 1150 mm. However, the average *kharif* season rainfall is 753.0 mm distributed from June to October. The mean maximum and minimum temperatures during the crop season experienced as 33.8 °C and 23.2 °C, respectively (Fig. 1). The average maximum and minimum relative humidity (%) during the crop season experienced as 76% and 57%, respectively. The experiment was laid out in randomized block design with four replications. The experiment consisted of ten treatments of inorganic and organic combinations of nutrient sources, *viz.* Control (no fertilizer); 100% recommended fertilizer dose (RFD) (60:40:20 NPK kg ha^{-1}); 50% RFD; 50% N (crop residue); 50% N (FYM); 50% RFD + 50% N (crop residues); 50% RFD + 50% N (FYM); FYM 10 t ha^{-1}; 100% RFD + $ZnSO_4$ 20 kg ha^{-1} and farmers' practice (FYM 4 t ha^{-1} + urea 40 kg ha^{-1}). Maize local (var. Mansar) was sown with the onset of monsoon and harvested in last week of September to 1st fortnight of October during the *kharif* seasons of 2014 to 2017. Maize crop was sown in lines in a unit plot size of 6 m x 4 m with a spacing of 60 cm x 20 cm, respectively. The farm yard manure (FYM) was applied one month before sowing on oven dry basis. The crop residues of wheat were incorporated in the soil one month before sowing. Urea, diammonium phosphate and muriate of potash were applied as a source of nitrogen, phosphorus and potassium, respectively.

Results and Discussion

Effect on growth

A perusal of the pooled data reveal that the growth parameters of maize crop such as plant height (cm) and dry matter accumulation (q ha^{-1}) were significantly influenced by different integrated nutrients management treatments. Among the integrated nutrient management treatments, highest plant height (199.1 cm) and dry matter accumulation (72.8 q ha^{-1}) were recorded with application of 50% RFD + 50% N (FYM) followed by 50% RFD + 50% N (crop residues) and 100% RFD + $ZnSO_4$ 20 kg ha^{-1}. However, the treatment with 50% RFD + 50% N (FYM) was statistically at par with the treatments comprising of 50% RFD + 50% N (crop residues), 100% RFD + $ZnSO_4$ 20 kg ha^{-1} and 100% recommended fertilizer dose (RFD) for dry matter accumulation (q ha^{-1}) (Table 1). This increase in growth parameters may be attributed to increased cell division and photosynthetic activity because of adequate supply of nutrients for longer periods. The results of present study are in agreement with the finding of several other investigators (Kokani *et al*., 2014; Manasa *et al*., 2015 and Tomar *et al*., 2017) [11, 12, 10].

Effect on yield attributes and yield

Yield attributes, which determine yield, are the resultant of the vegetative development of the plant. All the attributes of yield such as cob length (cm), cob girth (cm), stem girth (cm), grains cob^{-1} and 100 seed weight (g) were significantly influenced by the different integrated nutrient management treatments as compared to control during all the years of experimentation. Among the integrated nutrient management treatments, highest cob length (16.9 cm), cob girth (14.1 cm), stem girth (6.3 cm), grains cob^{-1} (308.9) and 100 seed weight (20.6 g) were recorded with application of 50% RFD + 50% N (FYM) followed by 50% RFD + 50% N (crop residues) and 100% RFD + $ZnSO_4$ 20 kg ha^{-1}. However, the treatments comprising of 50% RFD + 50% N (FYM) and 50% RFD + 50% N (crop residues) were found to be statistically at par for cob girth (cm), stem girth (cm) and 100 seed weight (g). However, the control evinced the lowest values of cob length (9.2 cm), cob girth (8.5 cm), stem girth (3.2 cm), grains cob^{-1} (140.5) and 100 seed weight (13.9 g). Similar finding were also been reported by (Kour *et al*., 2013 and Zaremanesh *et al*., 2017) [5, 13].

Significantly higher grain yield (1759 kg ha^{-1}) was recorded in 50% RFD + 50% N (FYM) over all the other integrated nutrient management treatments except for 50% RFD + 50% N (crop residues). However, significantly higher straw yield (4049 kg ha^{-1}) was recorded in 50% RFD + 50% N (FYM) over all the integrated nutrient management treatments. The control evinced the lowest values of grain yield (731 kg ha^{-1}) and straw yield (2171 kg ha^{-1}). Similar findings were also reported by Sharma and Gupta (1998) [7]. The increase in yield attributes and yield of maize with application of organic sources of nutrients in integration with inorganic sources may be attributed to the fact that organic sources (FYM and crop residues) being the store house of nutrients also made the release of applied nutrients at its optimum besides improving the soil physical conditions (Gupta *et al*., 2020) [9]. Similarly, the highest rain water use efficiency (RWUE) (2.9 kg ha^{-1}-mm) was recorded in the treatment comprising of 50% RFD +

50% N (FYM) over all other integrated nutrient management treatments except for 50% RFD + 50% N (crop residues). However, the lowest values of RWUE (1.2 kg ha^{-1}-mm) was recorded in control (Table 2).

Nutrient uptake

The uptake of N, P and K varied significantly among different integrated nutrient management treatments owing to the varying levels of fertilizer doses as well as sources of nutrients. This might be due to effect of rhizospheric conditions, as a result of varying levels of fertilizer doses and nutrient sources, on the extent and pattern of transformation, mineralization and transport of nutrients to the plant system. Significantly higher total uptake of N, P and K by maize was observed in the treatment comprising of 50% RFD + 50% N (FYM) over all other integrated nutrient management treatments. However, the treatment with 50% RFD + 50% N (FYM) was followed by 50% RFD + 50% N (crop residues) and 100% RFD + $ZnSO_4$ 20 kg ha^{-1}. The lowest values of total N, P and K uptake were observed in control (Table 2). Perusal of data also reveal that the integrated nutrtient management treatments (50% RFD + 50% N (FYM) and 50% RFD + 50% N (crop residues)) recorded significantly higher uptake of N, P and K over treatments comprising of inorganic sources of nutrients alone or organic sources of nutrients alone. Higher uptake of N, P and K may be attributed to the favorable effect of incorporation of organic sources along with inorganic nutrients which was earlier reported by Sharma *et al.* (2013) [6] and Gupta *et al.* (2021) [3].

From the present study it may be inferred that higher maize yield and nutrient uptake can be obtained with integrated application of organic and inorganic sources of nutrients. The productivity of maize crop can be increased with application of 50% RFD + 50% N (FYM) in rainfed conditions of Jammu and Kashmir.

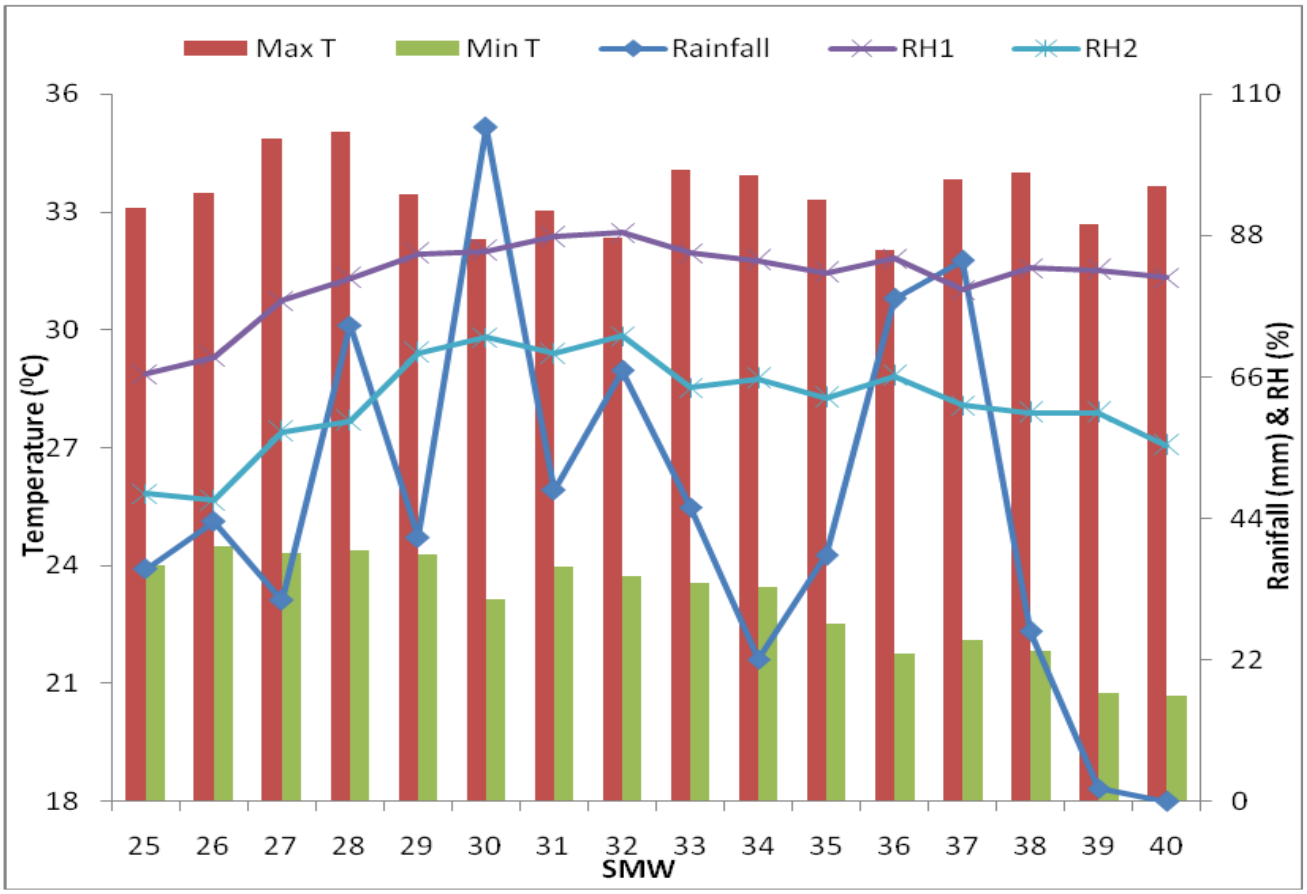

Fig 1: Meteorological variables during crop growing seasons of *kharif* 2014 to 2017 (pooled data of 4 years)

Table 1: Effect of Integrated nutrient management on growth and yield attributes parameter of maize (Data pooled over four years)

Treatment	Plant height (cm)	Dry matter accumulation (q ha^{-1})	Cob Length (cm)	Cob girth (cm)	Stem girth (cm)	Grains cob^{-1}	Seed index 100 seed weight
T_1	154.1	49.5	9.2	8.5	3.2	140.5	13.9
T_2	174.4	64.3	14.6	12.4	5.4	266.3	19.2
T_3	163.8	56.8	13.1	10.9	5.0	207.0	16.5
T_4	169.0	52.5	13.4	11.5	4.4	216.7	17.4
T_5	170.6	58.3	13.0	11.9	4.3	230.3	18.0
T_6	185.2	69.3	15.7	13.4	6.0	278.4	19.7
T_7	199.1	72.8	16.9	14.1	6.3	308.9	20.6
T_8	171.0	65.0	13.5	12.1	4.0	249.1	19.5
T_9	178.9	67.0	15.1	12.9	5.6	271.7	20.3
T_{10}	176.3	63.5	13.6	11.7	5.2	253.4	18.2
CD (p=0.05)	8.21	13.62	0.86	1.19	0.51	18.09	1.27

Table 2: Effect of Integrated Nutrient Management on yield and uptake Nutrient (Data pooled over four years)

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	RWUE (kg ha^{-1}-mm)	Nutrient uptake (kg ha^{-1})		
				N	P	K
T_1	731	2171	1.2	26.22	5.65	22.7
T_2	1520	3588	2.5	51.12	10.41	43.0
T_3	1088	2894	1.8	38.00	7.85	33.4
T_4	1059	2719	1.7	36.98	7.74	31.3
T_5	1093	2696	1.8	38.31	8.05	31.7
T_6	1623	3826	2.7	58.52	11.78	46.4
T_7	1759	4049	2.9	67.51	12.79	52.9
T_8	1470	3496	2.4	49.21	9.91	40.8
T_9	1573	3684	2.6	54.35	10.87	44.1
T_{10}	1401	3222	2.3	46.55	9.31	35.1
CD (p=0.05)	137.58	200.59	0.22	3.54	0.69	2.85

References

1. Anonymous. Agricultural Statistics at a Glance. Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation and Farmers Welfare, Directorate of Economics & Statistics, Government of India, New Delhi; c2017.
2. Abrol V, Sharma V, Sharma P, Khar D, Vittal KPR, Sharma KL. Direct and residual effect of organic and inorganic sources of nutrients on maize (*Zea mays*)-mustard (*Brassica napus*) cropping sequence under rainfed conditions. Indian Journal of Dryland Agricultural Research and Development. 2007;22(1):82-89.
3. Gupta Vishal, Sharma Akash, Rai PK, Gupta SK, Singh Brajeshwar, Sharma SK, *et al*. Corm Rot of Saffron: Epidemiology and Management. Agronomy. 2021;11(2):339.
4. Jamwal JS. Production potential and economics of different crop sequences in rainfed area of Jammu. Indian Journal of Agronomy. 2000:45(2):269-273.
5. Kour Manpreet, Singh KN, Singh Mahender, Thakur NP, Kachroo Dileep, Sharma Rohit. Assessment of climate change and its impact on growth and yield of wheat under temperate and sub-tropical conditions. Journal of Agrometeorology. 2013:15(2):142-146.
6. Sharma GD, Thakur R, Som R, Kauraw DL, Kulhare PS. Impact of integrated nutrient management on yield, nutrient uptake and protein content of wheat (*Triticum aestivum*) and soil fertility in a typic Haplustert. The Bioscan. 2013:8(4):1159-1164.
7. Sharma MP, Gupta JP. Effect of organic materials on green yield and soil properties in maize (*Zea mays*)-wheat (*Triticum aestivum*) cropping system. Indian Journal of Agricultural Sciences. 1998:68(11):715-717.
8. Singh B, Kumar A, Abrol V, Singh AP, Kumar J, Sharma A. Integrated plant nutrient management on pearlmillet (*Pennisetum glaucum*) productivity in rainfed subtropic *Shiwalik* foothills of Jammu and Kashmir. Indian Journal of Agronomy. 2018;63(2):195-197.
9. Singh B, Kumar A, Gupta V, Abrol, Singh AP, Kumar J, *et al*. Effect of organic and inorganic nutrients on pearl millet (*Pennisetum glaucum*)-gobhi sarson (*Brassica napus* var. napus) cropping sequence. Indian Journal of Agricultural Sciences. 2020;90(2):302-306.
10. Tomar SS, Singh A, Dwivedi A, Sharma R, Nares RK, Kumar V, *et al*. Effect of integrated nutrient management for sustainable production system of maize (*Zea mays* L.) in indo-gangetic plain zone of India. International Journal of Chemical Studies. 2017:5(2):310-316.
11. Kokani JM, Shah KA, Tandel BM, Nayaka P. Growth, yield attributes and yield of summer black gram (*Vigna mungo* L.) as influenced by FYM, phosphorus and sulphur. In. Proceedings of national conference on harmony with nature in context of environmental issues and challenges of the 21st century, Special issue, The Ecoscan. 2014;6:429-433.
12. Mansasa V, Hebsur NS, Malligawad LH, Shiva Kumar L, Ramakrishna B. Effect of water soluble fertilizers on utake of major and micro nutrients by ground and post-harvest nutrient status in a vertisol of northern transition zone of Karnataka. The Ecoscan. 2015:9(1-2):01-05.
13. Zaremanesh H, Nasiri B, Amiri A. The effect of vermicompost and biological fertilizer on corn yield. Journal Material Environment Science. 2017:8(1):154-159.