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Studies about in-situ green manuring and nitrogen management on yields, economics and quality of maize (*Zea mays* L.)

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Abstract
A field experiment was conducted at the Student's Instructional Farm of C. S. A. University of Agriculture and Technology, Kanpur during *kharif* season of 2019 to find out "Studies about in-situ green manuring and nitrogen management on yields, economics and quality of maize (*Zea mays* L.)" The twelve treatments were comprises i.e. control (No green manure and no nitrogen), no green manure+ 100kg N/ha, no green manure+ 150kg N/ha, no green manure+ 225kg N/ha, maize sown after in situ green manuring + 0 kg N/ha, maize sown after in situ green manuring + 100 kg N/ha, maize sown after in situ green manuring + 150 kg N/ha & maize sown after in situ green manuring + 225 kg N/ha, maize sown into standing dhaincha + 0kg N/ha, maize sown into standing dhaincha + 100kg N/ha, maize sown into standing dhaincha +150kg N/ha & maize sown into standing dhaincha + 225kg N/ha with Randomized Block Design and replicated thrice. The soil of the experimental plot was sandy loam in texture with pH 7.9 & EC of 0.32 ds/m at 25°C. It contained 0.43% organic carbon. Results revealed that the plots where maize was sown after incorporation of green manure and with the supply of 150 kg N/ha treatment promoted significantly the yield, economics and quality as compared to all remaining treatments. The treatment of maize sown after in-situ green manuring has done and at a dose of 225 kg N/ha observed grain yield (82.54 q/ha) which is non significantly higher than 150kg N/ha (81.92q/ha) with a net return of Rs.1,13,514.50/ha at 150kg/ha and the maximum nitrogen uptake & nitrogen use efficiency were recorded in maize raised after dhaincha green manuring with 225 and 100 kg nitrogen/ha, respectively over other treatments.

Keywords: Dhaincha, nitrogen uptake and nitrogen use efficiency

Introduction
Despite the fact that its current productivity is higher than major cereal crops, the yield productivity is below its potential. For instance, the potential yield of late maturing hybrid maize varieties can produce up to 9.5-12 t/ha at research field and 6-8.5 t/ha at on farm field whereas as the average national productivity is 3.32 t/ha (source: Directorate of economics and statistics, DAC & FW)). Uttar Pradesh accounts for 6.1% (ICMR, New Delhi) of the total maize production in the country. Andhra Pradesh has recorded highest production 4.14 mt. (ICMR, New Delhi). Even though many biotic and abiotic factors can contribute to these big yield gaps, soil fertility depletion and poor nutrient management are among the major factors contributing to low productivity.

Nitrogen management in maize production system is one of the main concerns since it is the most important and primary nutrient for growth and development of the crop. Hence, application of fertilizer nitrogen resulting in higher biomass is commonly increased. Optimum rate and time of nitrogen application can enhance yield, productivity and nitrogen use efficiencies while reducing the environmental pollution. N application beyond the optimum requirement of maize could not increase yield but may lead to an elevated level of NO3 in the soil and susceptibility to NO3 loss by leaching. Another report also indicated that abundant N supply favours NH3 losses, especially if the supply is in excess of plant nutrient requirement. However, the negative environmental impacts associated with maize production can be minimised through efficient nitrogen management, including appropriate rate and time of nitrogen recommendation.

The time of nitrogen application at appropriate crop growth stage is also another main focus to enhance N use efficiency and increase maize productivity. All applied N is not absorbed by the crop since leaching is one of the main challenges for N losses in high rainfall areas. Research reports had shown that about 50% and even more than this figure at higher doses of nitrogen remain unavailable to a crop due to loss of N through leaching. This leaching loss may be determined by a quantity of rainfall drops in an area. However an optimum and efficient time of N application can increase the recovery of applied nitrogen up to 58-70% and hence increase the yield and grain quality of the crop.

Materials and Methods

An experiment was carried out during kharif season of 2019 at student's Instructional Farm (SIF) of Chandra Sekhar Azad University of Agriculture and Technology, Kanpur. The experimental field was situated in the central part of Uttar Pradesh at an elevation of 129.0 meters above mean sea level. The present investigation was conducted in field no.1 at student's instructional farm (SIF) of Chandra shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India, during kharif season 2019. The experimental field was well levelled and had assured irrigation facility through tube well. The soil of the experimental field was sandy loam in texture, low in nitrogen, medium in phosphorus and high in potassium content. The twelve treatments i.e. control (No green manure and no nitrogen), no green manure+ 100kg N/ha, no green manure+ 150kg N/ha, no green manure+ 225kg N/ha, maize sown after in situ green manuring + 0 kg N/ha, maize sown after in situ green manuring + 100 kg N/ha, maize sown after in situ green manuring + 150 kg N/ha & maize sown after in situ green manuring + 225 kg N/ha, maize sown into standing dhaincha + 0kg N/ha, maize sown into standing dhaincha + 100kg N/ha, maize sown into standing dhaincha +150kg N/ha & maize sown into standing dhaincha + 225kg N/ha were comprising in Randomized Block Design and replicate three times. The broadcasting of seeds of Dhaincha green manure crop were taken up @ 25 kg/ha on two different dates as per the systems of green manuring in-situ in main plots. Green manure Dhaincha was incorporated after attaining 30 days of growth in all the plots. Sowing time of green manure crop was adjusted in such way that the sowing of maize was same for all the treatments (i.e. on 12.07.2019). Incorporation was done at flowering stage when green manure crop attained 5 weeks of age in two different ways as per the treatments), Dhaincha was sown on 05.06.2019 and incorporated at 5 weeks age and then maize was sown 12.07.2019. The cobs harvested from net plot were dried thoroughly under the sun. The stover was dried under the sun separately for recording the weights. Shelling was done with a hand operated maize sheller.

Results and Discussion

Effect of treatments on yields and economics of maize

The grain yield data obtained from the plots given 150kg N/ha shows a significant increase than 100kg N/ha and the highest yield (82.54q/ha) was obtained from the plot given a nitrogen dose of 225kg N/ha. *in case of green manuring* the effect of green manure in situ shows a significant result where maize was sown after one week when incorporation of green manure was over than the other treatments where no green manure crop was taken. The economics is calculated by taking all the cost incurred in all the activities. It was observed that the B:C ratio was highest (2.87) in the treatment where maize was sown after the incorporation of green manure and with a combination of 150kg N/ha. The lowest B:C ratio was observed in the treatment combination of maize sown into standing dhaincha crop with 150kg N/ha (0.79). The highest gross income (Rs.1,53,304.50/ha) & net income of (Rs.1,14,107.40/ha) was obtained from the 150kg N/ha treatment. The beneficial contribution of green manures with 150 kg/ha nitrogen may have yielded as much as that with 225 kg N/ha. The similar findings were correlated with Tiwari *et al* (2004) [8], Sharma and Behera (2009) [7] and Hirel & Dubois (2011) [4].

Effect of treatments on quality of maize

The nutrient uptake is highest in the plots given 225kg N/ha but this increase was non significant from the plots of 150kg N/ha. The increase was significantly higher from 100 kg N/ha to 150 kg N/ha and hence the recommended dose will be 150kg N/ha. Here in case of the green manuring treatments maize sown after incorporation of green manure gives a significant response than other treatments where no green manure was taken and maize sown into standing crop of dhiancha. The nitrogen use efficiency is highest in the plots given 100 kg N/ha along with incorporation of green manure and then sowing of maize after one week of incorporation. The lowest nitrogen use efficiency was obtained from plots given 100kg N/ha and no green manure treatment at all. The enhance of uptake and utilization efficiency of N applied, root structure and its functioning are greatly associated with N uptake, while sink capacity may limit the uptake. Higher uptake of nitrogen in this treatment (G2) at higher nitrogen levels might be due to better availability of nitrogen in soil after decomposition. Excessive dose of nitrogen is reported to inhibit root growth and development, thus reducing the ability of roots to absorb nutrients and water efficiently. Higher NUE values with maize sown after green manuring compared with other systems of green manuring in-situ at each level of nitrogen might be due to better utilization of nitrogen. This is in conformity with the findings of, Bhandari *et al.* (1989) [2], Peter *et al.* (2000) [5], Sakala *et al.* (2003) [6] and Hawkesford *et al.* (2014) [3].

Table 1: Performance of in-situ green manuring and nitrogen management on yield, economics and quality of maize (*Zea mays* L.)

Treatment	Grain yield (q/ha)	Net income (Rs./ha)	Gross income (Rs./ha)	B:C ratio	Nitrogen Uptake	Nitrogen Use Efficiency
Green manure						
G_1	67.89	90,898	1,27,029.60	2.50	103.72	12.65
G_2	77.82	1,04,959	1,45,424.10	2.58	128.1	23.11
G_3	66.54	85,472	1,25,936.60	2.09	107.95	21.00
SE (d) ±	0.197	343.48	352.87	0.008	0.333	0.21
CD at 5%	0.582	1013.91	1041.62	0.025	0.098	0.44
Nitrogen levels (kg/ha)						
Control	42.44	44,367	82,199.47	1.18	68.09	0.00
100 kg/ha	75.41	1,02,118	1,40,851.70	2.62	121.79	32.97

150 kg/ha	81.92	1,13,514.50	1,52,831.40	2.87	131.15	24.73
225 kg/ha	82.54	1,14,107.40	1,53,304.50	2.88	132.01	18.12
SE (d) ±	0.227	686.97	407.46	0.010	0.385	0.24
CD at 5%	0.671	2027.83	1202.76	0.029	1.13	0.51

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