



ISSN (E): 2277- 7695

ISSN (P): 2349-8242

NAAS Rating: 5.03

TPI 2020; 9(3): 545-547

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[www.thepharmajournal.com](http://www.thepharmajournal.com)

Received: 23-01-2020

Accepted: 25-02-2020

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## Impact of INM in rainfed conditions

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### Abstract

The productivity of crops in Agra region is very low due to low water holding capacity, low fertility, hostile climate and unfavorable edaphic conditions. To enhance productivity and profitability, INM practices were demonstrated at farmer's field. Improved INM practices resulted in increasing yield, higher net returns and B: C ratio over farmer's practices. Mustard yield increased by 29.48 percent when sesbania was used as green manure.

**Keywords:** Green manuring, sesbania, split application, potassium application, net returns

### Introduction

Rainfed agriculture is practiced on two thirds of the total cropland area of 162 million hectares in India. While yield and total productivity of irrigated crops have improved since the 1960s, and those of rainfed crops or dry farming have stagnated. Low crop yields under rainfed conditions are due to recurring drought stress, high soil temperatures, widespread soil degradation & desertification and poor management. Soil related constraints that exacerbate drought stress include crusting and compaction, low water infiltration rate, low water retention capacity, high surface run off and high losses due to soil evaporation. Efforts are being made to increase the productivity in this region through efficient management of all available water resources including harvesting of rain water and its judicious utilization along with integrated nutrient management. In order to evaluate and disseminate the improved INM practices, trials and demonstration were conducted at NICRA village Nagla Dulhe Khan.

### Materials and Methods

Trials were conducted for six years during 2011-2016 at the village *Nagla Dulhe Khan & Faziyatpura* tehsils Kheragarh, Distt. Agra, Uttar Pradesh under NICRA. *Nagla Dulhe Khan* is situated in the South-Western part of Agra and lies between 26°55' to 26°56' North latitude and 77°40'30" to 77°42'30" east longitude, its distance from Agra city is about 65 Km. The results have been analyzed in randomized block design by using the number of farmers as replications.

The annual rainfall received during 2011-12 to 2016-17 varied from 418.8 to 1119.4 mm with the average value of 762.9 mm which was 14.8 per cent more over the mean normal rainfall. The rainfall received during *kharif* season (June- September) ranges from 313.4 to 942.1 mm with mean value of 650.1 mm and during *rabi* season (October – March) ranges from 32.0 to 204.1 mm with mean value of 94.1 mm. The major soil types are sandy loam to loamy sand. The major crops in *kharif* under rainfed are pearl millet, pigeon pea, green gram, black gram, sesame and sorghum (for fodder purpose). Major crops in *rabi* are mustard, barley, chickpea, lentil, linseed in rainfed conditions. Wheat and potato are also grown under assured irrigated conditions. The source of irrigation is bore well covering 30% of cultivated area. The availability of nitrogen and potash are low while availability of phosphorus is medium in the soil.

### Results and Discussion

The results of different integrated nutrient management practices are discussed below.

#### Green manuring (Sesbania) in oil seed (mustard)

Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, growth regulators and livestock feed additive. Green manuring is the practice of enriching the soil by ploughing under or soil incorporation of any green manure crops while they are green or soon after they start flowering.

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The organic matter in the soil is recognized as being one of its most valuable constituents for real soil fertility. A green manure crop can be substitute to 50-60 kg fertilizer N/ha (Sharma *et al.* 2013) [7]. The trials from 2011 to 2016 were conducted to study the effect of green manuring (sesbania) on mustard. When sesbania was used as green manure the mustard average yield was recorded 1783 kg/ha which was 29.48% more when mustard was grown without green manure. The average net return and BC ratio in green manuring was Rs. 56340/-per hectare and 4.47 respectively. Maiksteniene and Arlauskienė (2004) [4] reported that green manuring in the absence of fertilizer nitrogen, decreased the mustard yield. But the combined application of green manure with 100 kg N/ha further improved the yield potential of

mustard, illustrating the benefit at any amount of fertilizer N cannot achieve. Patel (1998) [2] reported that incorporation of either of the three green manure crops, *S. rostrata*, *S. aculeate* or *C. juncea* was comparable with that of 100 kg nitrogen/ha for grain yield of 5 ton/ha during summer. Lekha Sreekantan and Palaniappan (1990) [3] reported better utilization of P and K to an extent of 10 to 12 per cent due to green manure incorporation. Dhanicha, sunhemp, mung bean and guar grown during kharif season as green manure crops have been reported to contribute 8-21 tones of green matter and 42-95 kg. of N/ha. Similarly, Khesari, cowpea and berseem grown during rabi season can contribute 12-29 tons of green matter and 67-68 kg of N/ ha (Mishra and Naik, 2004) [6].

**Table 1:** Effect of green manuring on mustard yield under rainfed conditions

| Treatments             | Grain yield (kg/ha) |         |         |         |         |         | Average | Average Net return (Rs./ha) | Average B:C ratio |
|------------------------|---------------------|---------|---------|---------|---------|---------|---------|-----------------------------|-------------------|
|                        | 2011-12             | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 |         |                             |                   |
| Green Manuring         | 2206                | 2296    | 1775    | 950     | 1085    | 2287    | 1783    | 56340                       | 4.47              |
| Without green manuring | 1496                | 1850    | 1375    | 800     | 879     | 1862    | 1377    | 41701                       | 3.95              |

### Split application of nitrogen in pearl millet

In most cases, nitrogen fertilizer is the most costly major nutrients in any fertilizer programme. By replacing all the nitrogen requirements at seeding, a producer must rely on adequate rainfall during the growing season, so the crop can efficiently utilize the nitrogen. Split application is the process of matching nitrogen supply for a pre established target yield and a given level of soil moisture, and then supplying the remaining nitrogen as moisture conditions improve. Split

application of nitrogen three times (1/3 at sowing, 1/3 at tillering and 1/3 at flowering stage) gave maximum average yield of 2375 kg/ha, which was 30.06% higher over top dressing. Highest net return of 20774 Rs/ha and BC ratio of 5.61 was also observed. This might be due to split application reduces the exposure of nitrogen in saturated soils where the potential for losses such as leaching and denitrification are increased. Split application of nitrogen can be effective in increasing grain protein (Smith *et al.* 1991) [9].

**Table 2:** Effect of split application of nitrogen on pearl millet yield under rainfed conditions

| Treatments          | Grain yield (kg/ha) |         |         |         |         |         | Average | Average Net return (Rs./ha) | Average B:C ratio |
|---------------------|---------------------|---------|---------|---------|---------|---------|---------|-----------------------------|-------------------|
|                     | 2011-12             | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 |         |                             |                   |
| Split N three times | 3034                | 2838    | 2401    | 2344    | 1085    | 2549    | 2375    | 20774                       | 2.42              |
| Only top dressing   | 2067                | 2228    | 1968    | 1820    | 950     | 1852    | 1826    | 13665                       | 2.02              |
| Rainfall (mm)       | --                  | 757.8   | 787.3   | 239.0   | 273.0   | 396.5   | --      | --                          | --                |

### Influence of potassium application on mustard

Potassium is the second most absorbed mineral element by the plants coming after nitrogen and in some cases calcium. As the yield and yield components have increased significantly by an elevation in different levels of potassium (Amanullah *et al.* 2011) [1] Addition of 50 kg K<sub>2</sub>O + RDF produces 1862 kg/ha average yield which was 33.67% higher

over farmers practices. The average net return and BC ratio in potassium application was Rs. 59530/ha and 4.68, respectively. These results are supported by that of Mir *et al.* (2010) [5] who reported that seed yield increased with increasing amount of potassium. Significant increase in seed yield of mustard due to potassium application was also reported by Singh *et al.* (2010) [8].

**Table 3:** Effect of potassium on mustard yield under rainfed conditions

| Treatments                                    | Grain yield (kg/ha) |         |         |         |         |         | Average | Average Net return (Rs./ha) | Average B:C |
|---|---------------------|---------|---------|---------|---------|---------|---------|-----------------------------|-------------|
|   | 2011-12             | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 |         |                             |             |
| Potash application (RDF+50kgK <sub>2</sub> O) | 2265                | 2473    | 1740    | 1025    | 1115    | 2555    | 1862    | 59530                       | 4.68        |
| RDF Only                                      | 1548                | 1849    | 1370    | 832     | 846     | 1915    | 1393    | 42310                       | 4.01        |

### Conclusion

Present study indicated that by adopting improved INM practices for different crops can enhance the crop yield. The INMs helps to restore and sustain soil fertility and productivity. The percent increase in the yield was highest with adaption of potash application (33.67) followed by split application of N (30.06) and green manuring (29.48). By adopting improved INM practices in different crops farmers can achieve higher productivity and profitability on sustainable basis and can restore the soil fertility. Results of demonstration at farmer's field clearly indicated that improved INM practices were superior over farmer's practices in increasing crop yield and net returns. Study

suggested that the productivity and profitability could be enhanced considerably at farmer's field by adopting suitable improved INM practices during various seasons in NICRA village Agra.

### Acknowledgement

Authors sincerely thank to all the farmers on whose field trials were conducted. Authors are grateful to All India Coordinated Research Project on Dryland Agra for providing necessary facilities to carry out the work. The author is extremely grateful to CRIDA, Hyderabad for providing financial help for taking this study under NICRA.

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