

## PRODUCTIVITY AND ECONOMICS OF PEARL MILLET AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT

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### ABSTRACT

A field experiment was conducted in sandy loam soil at Bichpuri (Agra) to study the effect of integrated nutrient management on yield and profitability of pearl millet during Kharif season of 2010 and 2011. Treatments consisted of 3 levels of NPK and combination of NPK + FYM and green manure (dhaincha) were evaluated thrice in a randomized block design. Results revealed that the levels of NPK fertilizers significantly improved the plant height, effective tillers, ear length, ear girth, ear weight, test weight, grain and stover yield of pearl millet over control. The maximum values of these parameters were recorded at 100% NPK (80 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> + 40 kg K<sub>2</sub>O ha<sup>-1</sup>) level over lower levels of NPK and control. The combined application 75% NPK + 4 t FYM ha<sup>-1</sup> further improved these parameters over 100% NPK alone. Application of 75% NPK + 2.75 t dhaincha ha<sup>-1</sup> also improved these parameters. The enhanced yield under 75% NPK + 4 t FYM ha<sup>-1</sup> or 75% NPK + 2.75 t dhaincha ha<sup>-1</sup> also resulted in higher net returns and benefit: cost ratio (1.66). Farmer fertilizer practice proved sub optimal and insufficient for pearl millet production.

**Key words:** Productivity, economics, pearl millet, integrated nutrient management.

### INTRODUCTION

Pearl millet [(*Pennisetum glaucum* L.) R. Br. Emend Stanz] is the fourth most important cereal crops and widely grown in India because of its tolerance to drought, high temperatures and low soil fertility. Pearl millet grain is the staple diet and nutritious source of vitamins, minerals and protein, while pearl millet stover is a valuable livestock feed. The productivity of pearl millet is quite low in Agra region mainly due to sub-optimal application of fertilizers and cultivation on marginal lands in rainfed condition. In plant nutrition, organic matter of a soil is the key property that decides the availability status of essential nutrients. Integrated nutrient management system through efficient use of organic matter, besides improving soil physical condition and conservation of moisture, can substantially enhance crop production. The nutrient supply, the flows and the nutrient added should be managed properly to achieve as high yield as possible under the climatic circumstances while minimizing environmental pollution (Finck, 1998). The use of organic matter (FYM) or green manure (dhaincha) is the tool to improve physical, chemical and biological properties of the soil. Farmyard manure being the source of all essential elements, improves soil organic matter and humus part of soil. FYM also plays important role in habitation beneficial bacteria, thus, making the nutrients available to crops. Integrated plant nutrition involves judicious and integrated use of chemical fertilizers alongwith organic manure and green manure. Keeping this in view, present investigation

was undertaken to find out the effect of INM on productivity and economics of pearl millet.

### MATERIALS AND METHODS

A field experiment was conducted during rainy (Kharif) season of 2010 and 2011 at Agriculture Research farm, R.B.S. College Bichpuri (27°2' N, 77°9' E and at altitude of 163.4 m mean sea level) Agra (Uttar Pradesh). The experimental soil was sandy loam, slightly alkaline in reaction (pH 7.8), low in organic carbon (3.1 g kg<sup>-1</sup>) and available N (155 kg ha<sup>-1</sup>), low in available P (9.5 kg ha<sup>-1</sup>) and medium in K (125 kg ha<sup>-1</sup>). The experiment was laid out in randomized block design with 3 replications. The treatments namely T<sub>1</sub>, control, T<sub>2</sub>, 50% RD NPK, T<sub>3</sub>, 75% RD NPK, T<sub>4</sub>, 100% RD NPK (80 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> + 40 kg K<sub>2</sub>O), T<sub>5</sub>, 50% RD NPK + 8 t FYM ha<sup>-1</sup>, T<sub>6</sub>, 75% RD NPK + 4 t FYM ha<sup>-1</sup>, T<sub>7</sub>, 50% RD NPK + 5.5 t dhaincha ha<sup>-1</sup> + T<sub>8</sub>, 75% RD NPK + 2.75 t dhaincha ha<sup>-1</sup> and T<sub>9</sub>, farmer fertilizer practice (40 kg N ha<sup>-1</sup>) were replicated three times in randomized block design. The N, P and K were applied through urea, diammonium phosphate and muriate of potash, respectively. Phosphorus and potassium were applied to the plots as per treatments at the time of sowing. Half dose of N was applied basal and remaining half dose was applied in two splits as per treatment. Quantity of FYM (N 0.46%, P 0.28% and K 0.44%) and green leaf manure (dhamcha) were calculated as per their treatment and thoroughly mixed in respective plots. Pearl millet (Bio 8510) was sown in first week of July in both the years. The crop was harvested at the physiological maturity. The other

crop management practices were followed as per standard recommendations. The growth, yield attributing characters and yields were recorded at harvest. The economics was computed using the prices of inputs and outputs as per prevailing market rates. The data generated for both years were pooled together and analyzed statistically.

## RESULTS AND DISCUSSION

Application of 100% NPK (80 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> + 40 kg K<sub>2</sub>O ha<sup>-1</sup>) registered the highest values of growth attributes while lowest values were obtained under no fertilizer application (control). The greater availability of nutrients in soil due to increasing fertilizer application might have enhanced meristematic activity (multiplication and elongation of cells) leading to increased plant height and yield

attributes. Our results support the findings of Singh *et al.* (2013). Among the INM practices, application of 75% RD NPK + 4 t FYM ha<sup>-1</sup> recorded significantly taller plants and other parameters as compared to the other treatment. The minimum plant height was recorded under control. This is probably because FYM combined with fertilizers released the nutrients probably at faster rate and enriched the soil owing to providing sufficient amount of nutrients that are essentially required to various metabolic processes. This resulted in better mobilization of synthesized carbohydrates in the amino acids and proteins, which in turn stimulated rapid cell division and cell elongation and facilitated the faster vegetative growth and leads to higher internodal elongation and finally enhanced the plant height (Amgain *et al.* 2013).

Table 1: Effect of integrated nutrient management on growth and yield attributing characters of pearl millet (mean of two years)

| Treatments   | Plant height (cm) | Effective tiller/plant | Ear length (cm) | Ear girth (cm) | Ear weight (g) | Weight of grain/ear | 1000 grain weight (g) |
|--|-------------------|------------------------|-----------------|----------------|----------------|---------------------|-----------------------|
| T <sub>1</sub> Control                             | 148.5             | 1.3                    | 24.9            | 12.7           | 25.2           | 24.4                | 11.6                  |
| T <sub>2</sub> 50% NPK                             | 155.6             | 1.4                    | 26.7            | 13.5           | 26.7           | 25.4                | 11.9                  |
| T <sub>3</sub> 75% NPK                             | 165.5             | 1.5                    | 27.2            | 13.8           | 27.5           | 26.9                | 12.1                  |
| T <sub>4</sub> 100% NPK                            | 168.5             | 1.9                    | 28.3            | 14.0           | 30.0           | 28.9                | 13.5                  |
| T <sub>5</sub> 50% NPK + 8t FYM ha <sup>-1</sup>   | 168.0             | 1.5                    | 28.4            | 13.3           | 27.0           | 25.0                | 12.2                  |
| T <sub>6</sub> 75% NPK + 4t FYM ha <sup>-1</sup>   | 169.0             | 1.9                    | 29.0            | 14.6           | 29.5           | 27.6                | 12.0                  |
| T <sub>7</sub> 50% NPK + 5.5t GM ha <sup>-1</sup>  | 163.7             | 1.6                    | 27.8            | 13.1           | 27.3           | 24.8                | 12.8                  |
| T <sub>8</sub> 75% NPK + 2.75t GM ha <sup>-1</sup> | 168.6             | 1.9                    | 28.8            | 14.7           | 30.0           | 28.0                | 13.2                  |
| T <sub>9</sub> FFP (40kg N ha <sup>-1</sup> )      | 153.5             | 1.5                    | 24.9            | 12.3           | 27.2           | 24.8                | 11.7                  |
| CD (P=0.05)  | 7.5               | 0.9                    | 3.7             | 1.6            | 8.5            | 11.5                | 2.2                   |

### Yield attributing characters

Pearl millet responds well to fertilizer application and the increase due to each successive level of fertilizer applied was significant in ear length, ear girth and test weight (Table 1). The positive effect of fertilizer application on yield attributing characters of pearl millet seems to be due to cumulative effect on growth and vigour of plants. By virtue of increased supply of metabolites, there might have been significant improvement in growth characters with increasing fertilizer application. Increased growth components owing to increased fertilizer levels might have provided stability in higher supply of photosynthates towards the sink (grain/ear). The improvement in yield attributes with fertilizer application is in close conformity with Jat *et al.* (2013). Application of 80 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> + 40 kg K<sub>2</sub>O ha<sup>-1</sup> registered the higher values over their preceding lower levels. Combined application of fertilizers and FYM or green manure recorded higher values of yield attributes for yield attributes (ear length, ear growth, test weight etc.) over NPK levels alone (Table 1). The maximum values of these yield

attributes were recorded at 75% NPK + 4 t FYM ha<sup>-1</sup>. Both the treatments (50% NPK + 8 t FYM ha<sup>-1</sup> and 75% NPK + 4 t FYM ha<sup>-1</sup>) were statistically at par with respect to yield attributes. Similarly, 75% NPK + 2.75 t dhincha ha<sup>-1</sup> also resulted in higher values of yield attributes over NPK alone. This may be attributed to overall improvement in vigour and crop growth. The higher values of yield attributes are the result of higher nutrient availability which resulted in better growth and more translocation of photosynthates from source to sink (Jat *et al.* 2013, Priyadarshani *et al.* 2012).

### Yield

Application of graded levels of NPK fertilizers to pearl millet significantly enhanced the grain and stover yield (Table 2) over control. Highest grain and stover yields were recorded with 100% RD NPK (80 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> + 40 kg K<sub>2</sub>O ha<sup>-1</sup>) over rest of the NPK levels. Application of 100% NPK increased the grain and stover yield of pearl millet to the tune of 96.0 and 114.4% over the control, respectively. Significant increase in grain yield of pearl millet with increasing levels of

Table 2: Effect of integrated nutrient management on yield and economics of pearl millet (mean of two years)

| Treatments   | Biological yield (q ha <sup>-1</sup> ) | Grain yield (q ha <sup>-1</sup> ) | Stover yield (q ha <sup>-1</sup> ) | Harvest index | Net Profit (₹ ha <sup>-1</sup> ) | B:C ratio |
|--|--|-----------------------------------|------------------------------------|---------------|----------------------------------|-----------|
| T <sub>1</sub> Control                             | 31.4                                   | 10.7                              | 20.7                               | 34.0          | 1491.1                           | 0.22      |
| T <sub>2</sub> 50% NPK                             | 49.2                                   | 16.8                              | 32.4                               | 33.9          | 6224.5                           | 0.80      |
| T <sub>3</sub> 75% NPK                             | 58.6                                   | 19.1                              | 39.5                               | 34.5          | 8279.5                           | 1.01      |
| T <sub>4</sub> 100% NPK                            | 66.3                                   | 21.9                              | 44.4                               | 33.4          | 9647.5                           | 1.11      |
| T <sub>5</sub> 50% NPK + 8t FYM ha <sup>-1</sup>   | 66.0                                   | 21.0                              | 45.0                               | 31.8          | 9943.5                           | 1.26      |
| T <sub>6</sub> 75% NPK + 4t FYM ha <sup>-1</sup>   | 68.2                                   | 22.4                              | 45.8                               | 32.0          | 9833.5                           | 1.09      |
| T <sub>7</sub> 50% NPK + 5.5t GM ha <sup>-1</sup>  | 65.8                                   | 20.8                              | 45.0                               | 31.6          | 9857.5                           | 1.24      |
| T <sub>8</sub> 75% NPK + 2.75t GM ha <sup>-1</sup> | 67.8                                   | 22.7                              | 45.1                               | 32.5          | 10256.5                          | 1.16      |
| T <sub>9</sub> FFP (40kg N ha <sup>-1</sup> )      | 43.7                                   | 14.1                              | 29.6                               | 32.1          | 5216.5                           | 0.71      |
| CD (P=0.05)  | 9.2                                    | 1.5                               | 6.2                                | 1.3           | -                                | -         |

fertilizers might be due to improvement in yield attributes. Significant increase in stover and biological yield owing to fertilizer application might be because of increased plant height and profused tillering (Jat *et al.* 2013). Application of 75% NPK + 4 t FYM or 2.75 t green manure (dhaincha) in combination produced significantly higher grain and stover yield of pearl millet over other fertility treatments. Combined application of 75% NPK + 4t FYM ha<sup>-1</sup> produced higher grain yield of pearl millet by 109.3% and stover yield by 121.2% over control, while the increases in grain and stover yield due to 75% NPK + 2.75 t dhaincha ha<sup>-1</sup> were 112.1 and 117.8 percent. These findings indicate superiority of sub optimal (75% NPK) dose of fertilizer with organic manure over optimal (100% NPK) dose of fertilizer. Thus, the balanced use of fertilizer either alone or in combination with FYM or green manure is necessary for sustaining the higher productivity of crop (Priyadarshani *et al.* 2012, Jat *et al.* 2013).

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