Nitrogen and phosphorus nutrition of pearl millet (\textit{Pennisetum glaucum}) grown in sole and intercropping systems under rainfed conditions

D.K. SINGH\textsuperscript{1} AND R.L. AGRAWAL

\textit{Raja Balwant Singh College, Dr B R Ambedkar University, Bichpuri, Agra, Uttar Pradesh 283 105}

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\textbf{ABSTRACT}

A field experiment was carried out during the rainy seasons of 1997 and 1998 to assess the production potential and economics of intercropping of pearl millet \textit{(Pennisetum glaucum)} (L.) R.Br. emend. Stuntz] with pigeonpea \textit{(Cajanus cajan)} (L.) Millsp. and castor \textit{(Ricinus communis)} L. under varying fertility levels. The experiment was conducted in split-plot design with 3 cropping systems (pearl millet sole, pearl millet + pigeonpea and pearl millet + castor) in main plots and 4 sets of fertility levels (control, 40 kg N/ha, 40 kg N + 30 kg P\textsubscript{2}O\textsubscript{5}/ha, 80 kg N + 60 kg P\textsubscript{2}O\textsubscript{5}/ha) in sub-plots, replicated 4 times. Intercropping had no effect on yield attributes of pearl millet. Sole pearl millet gave significantly higher grain yield than pearl millet intercropped with pigeonpea or castor. Sole pearl millet recorded higher N and P uptake than intercropped pearl millet. The maximum pearl millet-grain equivalent net returns and benefit: cost ratio were obtained with pearl millet + pigeonpea followed by pearl millet + castor. Sole pearl millet recorded the lowest pearl millet-grain equivalent net returns and benefit: cost ratio. The yield and yield attributes of pearl millet: pearl millet-grain equivalent, N and P uptake and net returns were higher with higher dose, i.e. 80 kg N + 60 kg P\textsubscript{2}O\textsubscript{5}/ha. However, the maximum benefit: cost ratio was obtained with 40 kg N + 30 kg P\textsubscript{2}O\textsubscript{5}/ha and 80 kg N + 60 kg P\textsubscript{2}O\textsubscript{5}/ha (3.5).

\textit{Key words}: Pearl millet, Intercropping, Nitrogen, Phosphorus

Out of major rainfed coarse cereals, pearl millet is an important crop. The higher production potential of pearl millet in rainfed areas might be owing to deeper root system, better extraction of soil moisture and its efficient utilization, efficient photosynthetic mechanism and rapid translocation of photosynthates from leaves to the grain. The main consideration for mixed or intercropping is to cover the risk of failure and better use of natural resources, viz. sunlight, land and water. It may also have some beneficial effect on pest and disease problems. Growing short- and long-duration crops in a mixture helps to spread labour needs more evenly. Food crops are usually mixed with cash crops to help ensure both sustenance and disposable income. The pearl millet-growing areas, in general, are improvised and deficient in essential plant nutrients like nitrogen and phosphorus. When 2 crops of dissimilar nutrient requirements are grown together, it sometime becomes operatively difficult to meet the nutrient needs of 2 crops simultaneously. Therefore present investigation was undertaken to assess the production potential and economics of different intercroppings of pearl millet with various fertility levels.

\textbf{METHODS AND MATERIALS}

A field experiment was conducted during the rainy season of 1997 and 1998 on sandy-loam soil of Bichpuri, Agra, Uttar Pradesh. The soil was loamy sand in texture, low organic carbon (0.42%), available N (145 kg/ha), medium in available P (11.9 kg/ha) and available K (295 kg/ha) having pH 7.8. Treatments consisted of 3 cropping systems (sole pearl millet, pearl millet + pigeonpea and pearl millet + castor at 60 cm uniform row spacing) as main plots and 4 fertility levels (control, 40 kg N/ha, 40 kg N + 30 kg P\textsubscript{2}O\textsubscript{5}/ha and 80 kg N + 60 kg P\textsubscript{2}O\textsubscript{5}/ha) as sub-plots. replicated 4 times in split-plot design. Pearl millet cv. ‘Pusa 322’, pigeonpea cv. ‘Pusa 33’ and castor cv. ‘Aruna’ were sown with the onset of monsoon on 13 July in 1997 and 7 July in 1998. Pearl millet was harvested on 3 October in 1997 and 28 September in 1998. Nitrogen was applied in 2 equal splits, at sowing and 30 days after sowing. Phosphorus was applied as basal dose through single superphosphate. The total rainfall during crop season (July–December) was 676 mm in 1997 and 1,040 mm in 1998.

\textit{Present address}: \textit{Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar Campus, Srinagar, Jammu and Kashmir 191 121}
Two extra plots were taken in each replication sowing pigeonpea and castor with normal practice calculating the land-equivalent ratio (LER).

RESULTS AND DISCUSSION

Yield and yield equivalent

Yield attributes (length of ear, grain weight/ear and 1,000-grain weight) of pearlmillet were not influenced by cropping systems (Table 1). Bar and Gautam (1991) also reported that yield-contributing characters did not differ significantly due to intercropping of castor with pearlmillet. Sole crop of pearlmillet recorded significantly higher grain yield than intercropped one. Pearlmillet likely faced competition for nutrient and moisture due to identical growth behaviour of pigeonpea and castor. Since pearlmillet is a short-duration, quick growing crop as compared to pigeonpea and castor, contributed higher yield as yield equivalent. However, the difference between pearlmillet intercropped with pigeonpea or castor was not significant (Table 1). Similarly, Raj et al. (1993) reported reduction in yield of pearlmillet when intercropped with pigeonpea.

Fertility treatments significantly affected all the yield attributes and grain yield of pearlmillet. Each successive increase in fertilizer level from the control to the highest dose, recorded significant improvement in yield attributes and grain and stover yields of pearlmillet. The highest fertility level of 80 kg N + 60 kg P₂O₅/ha recorded significantly highest yield (31.04 q/ha), being 63.0% higher than the control. Increased yield of pearlmillet with increasing fertilizer levels might be attributed to significant improvement in the yield attributes.

The total productivity in terms of pearlmillet grain equivalent showed that pearlmillet + pigeonpea intercropping system recorded significantly higher pearlmillet grain equivalent than pearlmillet + castor and sole pearlmillet (Table 1). Pearlmillet + castor also recorded significantly higher grain-equivalent yield than sole pearlmillet. Higher market price of pigeonpea made it possible to record the maximum pearlmillet grain equivalent. Gautam (1994) also reported highest pearlmillet grain equivalent under pearlmillet + pigeonpea among the intercropping system. The highest fertility level of 80 kg N + 60 kg P₂O₅/ha resulted in the maximum pearlmillet grain equivalent (Table 1). Highest land-equivalent ratio (LER: 1.51) was recorded with pearlmillet + pigeonpea than pearlmillet + castor (1.46).

Nutrient uptake

The N and P uptake by pearlmillet was significantly influenced by cropping systems (Table 1). The N and P uptake was maximum with sole pearlmillet due to its

![Table 1. Pearlmillet yield attributes, grain, stover and intercrop yields, pearlmillet grain-equivalent ratio, land-equivalent ratio (LER), N, P uptake and economics as influenced by intercropping systems and fertility levels (pooled data of 1997 and 1998).](image-url)
higher grain yield. A significant increase was observed in N and P uptake with each increase in the fertilizer levels applied to pearlmillet (Table 1). The highest N and P uptake by pearlmillet was recorded with 80 kg N + 60 kg P₂O₅/ha. Saini et al. (1985) also reported higher N uptake by pearlmillet due to N and P fertilization.

**Economics**

The maximum net returns and benefit : cost ratio were obtained with pearlmillet + pigeonpea cropping system, followed by pearlmillet + castor. Higher fertility level of 80 kg N + 60 kg P₂O₅/ha recorded the maximum net returns. However, benefit : cost ratio in 40 kg N + 30 kg P₂O₅/ha and 80 kg N + 60 kg P₂O₅/ha was similar (3.5).

**REFERENCES**


