

# Effect of intercropping of niger in *kharif* proso millet (*Panicum miliaceum* L.) with organic and inorganic sources of nutrients on yield, economics and intercropping indices

A.N. UGALE, A.C. SAWANT\* AND P.G. CHAVAN

Department of Agronomy, College of Agriculture, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, RATNAGIRI (M.S) INDIA

## ABSTRACT

Field experiment conducted at Dapoli revealed that, niger is more remunerative intercrop in proso millet, as it enhanced the growth and yield of proso millet. It should be grown in 3:1 row ratio with the application of inorganic sources of nutrients for obtaining higher yields. When niger is grown as intercrop in proso millet was found economically profitable with different row ratios and with the application of inorganic sources of nutrients over organic source. Proso millet + niger in 3: 1 row ratio recorded higher net returns followed by 2: 1 row ratio. Higher cost benefit ratio was recorded in 3: 1 row ratio (1.77) followed by 2: 1 row ratio (1.73). Crop indices such as land equivalent ratio was higher in 1: 2 and 1: 3 row ratio (1.41), proso millet equivalent yield was more in 1: 3 row ratio (57.02) when applied with inorganic sources of nutrients, followed by 3: 1 row ratio (56.01). Relative crowding coefficient of proso millet was higher in 3: 1 row ratio (4.69) indicating more proso millet yield than expected yield. Similar trend was observed in case of aggressivity. Crop performance ratio was improved in 1: 2 and 1: 3 row ratios (1.66).

**Key words :** Proso millet, Niger, Intercropping, Sources of nutrients, Yield, Cropping indices and economics

## INTRODUCTION

Intercropping system is an age old practice of growing simultaneously two or more crops in the same piece of land at the same time or in the same season. It has been a common practice followed by the farmers of India, Africa, Sri Lanka and West Indies. The basic idea of intercropping is not only that two or more crop species grown together can exploit the resources better than either of them grown separately. But also when two or more crops occupy the same field, the inherent risk in agriculture and more so, under dry land conditions are buffered to some extent called as “biological insurance” (Ayyer, 1963).

Aiyer (1949) reported that the resources with regard to the plant nutrients present in the soil or added to it as manure were utilized to the fullest extent in mixed stand than when components were grown separately. The different crops having varying root depths extract moisture and nutrients from different soil layers. The periodical income and distribution of labour requirement throughout the year is of great help to poor cultivators.

Efficient utilization of nutrient, moisture, space and solar energy can be derived through mixed or intercropping system (Ayyer, 1963; and Francis and Heichel, 1973). Yield advantages in intercropping system are mainly because of differential use of growth resources by the component crop. The main way of complementarity occur when the growth pattern of component crop differ in time. The yield advantage in intercropping system is associated with efficient use of environmental resources

over time (Willey *et al.*, 1985).

## MATERIALS AND METHODS

The field experiment was conducted at the Agronomy farm Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli Maharashtra during the *kharif* season of 2007-2008, on red lateritic soil of Konkan region. The farm is located in tropical region on 17° N latitude and 73° E longitude at an elevation of 250 meter above the mean sea level. The variety used for experiment was Vari No. 10 and JNC-6 for proso millet and niger, respectively. The treatments consisted of five row ratios (1:1, 2:1, 3:1, 1:2, 1:3) along with sole crop of proso millet and niger and two resources of nutrient *i.e.* organic (5 t ha<sup>-1</sup> through FYM (W1) and inorganic (50% of recommended N and 100 % of P + K through sampurna (19:19:19) and remaining 50 % N top dressed through urea (W2)). There were 14 treatment combinations replicated thrice in randomized block design. The plot size was 4.8 x 3.6 meter. Seed rate were used 5 and 3 kg ha<sup>-1</sup> for both the crops, respectively. The crop was raised by using all recommended agronomic practices.

Line sowing of proso millet was done in nursery with well prepared raised bed of size 5 x 1 meter. After 15 days 1 kg N for 100 sq. m. areas was given, and transplanting was done after 20 days on main plot leaving rows for niger sowing. On the same day niger was sown in line in main plots. During the period of experiment, total rainfall was received 4260 mm. from June to October. Growth, yield attributes and yield were studied

and based on these characters the most efficient intercropping was evaluated.

## RESULTS AND DISCUSSION

### Grain yield of intercropping system :

Grain yield ( $q\ ha^{-1}$ ) of sole proso millet was significantly more than their respective intercrop ratios of 1:1, 2:1, 1:2 and 1:3. The proso millet + niger in 3:1 row ratio was found at par with sole proso millet and these treatments were significantly better than rest of the treatments. Grain yield of proso millet was found to increase due to application of inorganic sources of nutrient over the application of organic source of nutrient. Weight of grains per hectare was statistically affected due to different row ratios. Significantly highest weight of grains per hectare was recorded under sole crop of niger. Among the intercropping proso millet + niger in 1:3 row ratio recorded significantly higher weight of grains of niger per hectare followed by proso millet + niger in sole 1:2 row ratio over rest of the treatments. Weight of grains of niger per hectare was found to be increased due to inorganic sources of nutrients over organic source of nutrient. Similar findings were reported by Mahadkar and Khanvilkar (1988) and Maitra *et al.* (2001).

### Total net returns per hectare:

Among the sole crops, organic fertilizer application showed negative net returns over the application of inorganic fertilizers. Intercropping of proso millet with niger crops was more remunerative than sole proso millet. Proso millet + niger in 3:1 row ratio recorded higher net

returns followed by 2:1 row ratio. Total net return increased with increase in row proportion of proso millet.

### Cost benefit ratio:

Higher benefit cost ratio was recorded in intercropping system of proso millet + niger in 3:1 row ratio (1.77) followed by 2:1 row ratio (1.73). In all intercropping systems, benefit cost ratios increased with increase in row proportion of proso millet. The sole crops can be arranged in following descending order in terms of their benefit cost ratios *viz.*, proso millet > niger. Similar results were earlier reported by Shivkumar and Yadahalli (1995) and Sharma *et al.* (2006).

### Cropping indices:

#### Land equivalent ratio (LER):

Under almost all intercropping treatments, LER was more than one but, higher LER was recorded under proso millet + niger in 1:2 and 1:3 row ratios, *i.e.* (1.41) which was followed by proso millet + niger in 3:1, 2:1 and 1:1 row ratios, respectively. This indicated that there was 41 per cent yield advantage due to intercropping in respect of intercropping over sole.

#### Proso millet equivalent yield (PEY):

Under different intercropping treatments, higher proso millet equivalent yield was recorded under proso millet + niger in 1:3 row ratio (57.02), when applied with inorganic sources of nutrients, followed by proso millet + niger in 3:1 row ratio (56.01), when applied with inorganic sources of nutrients. All intercropping system showed

**Table 1 : Yield, economics and indices of intercropping system as affected by different treatments**

Treatments	Total net returns (Rs. $ha^{-1}$ )	B: C ratio	Grain yield ( $q\ ha^{-1}$ )		LER	PEY	NEY	RCC		Aggressivity		CPR		Total
			Vari	Niger				Vari	Niger	Vari	Niger	Vari	Niger	
T <sub>1</sub> W <sub>1</sub>	-859.00	0.94	11.7	-	1.00	33.21	11.07	-	-	-	-	-	-	-
T <sub>1</sub> W <sub>2</sub>	5309.20	1.40	13.97	-	1.00	41.93	13.97	-	-	-	-	-	-	-
T <sub>2</sub> W <sub>1</sub>	-4729.67	0.71	-	3.64	1.00	32.76	10.92	-	-	-	-	-	-	-
T <sub>2</sub> W <sub>2</sub>	3420.00	1.26	-	5.12	1.00	46.14	15.38	-	-	-	-	-	-	-
T <sub>3</sub> W <sub>1</sub>	1787.33	1.12	7.20	1.81	1.15	38.02	12.67	1.89	0.98	1.06	-1.06	1.30	1.00	2.30
T <sub>3</sub> W <sub>2</sub>	7718.03	1.59	8.26	2.97	1.13	49.94	16.64	1.45	1.19	0.91	-0.91	1.18	1.08	2.26
T <sub>4</sub> W <sub>1</sub>	1589.10	1.09	9.45	1.58	1.29	42.76	14.25	2.96	1.56	1.14	-1.14	1.28	1.31	2.59
T <sub>4</sub> W <sub>2</sub>	9521.70	1.73	10.96	2.43	1.25	54.77	18.25	1.79	1.83	1.01	-1.01	1.17	1.44	2.61
T <sub>5</sub> W <sub>1</sub>	2190.83	1.13	10.33	1.39	1.31	43.52	14.50	4.69	1.86	1.16	-1.15	1.24	1.52	2.76
T <sub>5</sub> W <sub>2</sub>	10092.86	1.77	12.07	2.20	1.29	56.01	18.67	2.11	2.26	1.04	-1.04	1.15	1.71	2.86
T <sub>6</sub> W <sub>1</sub>	2449.73	1.14	6.08	3.14	1.41	46.58	15.52	2.48	3.11	1.09	-1.09	1.66	1.29	2.95
T <sub>6</sub> W <sub>2</sub>	8699.23	1.67	7.19	3.43	1.11	49.50	16.50	1.61	1.00	0.89	-0.89	1.34	1.00	2.34
T <sub>7</sub> W <sub>1</sub>	1973.10	1.11	4.59	3.63	1.41	46.52	15.50	2.13	3.58	0.91	-0.89	1.66	1.21	2.87
T <sub>7</sub> W <sub>2</sub>	9020.93	1.69	5.20	4.60	1.27	57.02	19.00	1.78	2.91	0.82	-0.82	1.48	1.19	2.67

increase in equivalent yield of proso millet with increase in its population in the intercropping system.

*Relative crowding coefficient (RCC):*

Under proso millet + niger intercropping treatment the value of RCC for vari crop was recorded maximum at 3: 1 row ratio (4.69), indicating more proso millet yield than expected yield. While proso millet showed least yield in proso millet + niger in 1: 1 row ratio (1.45). Maximum RCC was observed in proso millet + niger in 1: 2 row ratio (3.11) treatment combination indicating that niger recorded more than expected yield.

*Aggressivity (A):*

Under proso millet + niger intercropping as regard to aggressivity index, it was observed that aggressivity index was maximum in proso millet + niger at 3: 1 row ratio *i.e.* (1.16) in case of proso millet over all treatment combinations. Aggressivity index of niger was negative indicating in case of intercropping system, dominance of proso millet in all intercropping combinations.

*Crop performance ratio:*

Under proso millet + niger intercropping ratios as regard to crop performance ratio of proso millet, it was observed that performance of proso millet + niger at 1: 2 and 1: 3 row ratios (1.66), however, it was lower in proso millet + niger at 3:1 row ratio, (1.15). Similarly, the performance of niger was better in proso millet + niger at 3: 1 ratio than all other ratios.

As regard to combined crop condition of proso millet and niger performance was comparatively better at proso millet + niger at 1: 2 ratio (2.95) than all other ratios. This indicated improvement in yield due to 1: 2 intercropping combination over their sole crop yield. Similar results of cropping indices were earlier reported by More (1990), Maitra *et al.* (2001).

## REFERENCES

- Aiyer, A.K.Y.N. (1949).** Mixed cropping in India. *Indian J. agric. Sci.*, **19** : 439-523.
- Ayyer, A.J.Y.N. (1963).** *Principles of Crop Husbandry in India*. Bangalore press, pp. 406.
- Francis, C.A. and Hiechel, G.H. (1973).** Efficacy of energy production in maize, bean and other mixed cropping systems. *Agron. abstract, USA*, pp. 72-73.
- Mahadkar, U.V. and. Khanvilkar S.A (1988).** Studies on intercropping of *khari*f-ragi with grain legume. *J. Maharashtra agric. Univ.*, **13** (3) : 364-366.
- Maitra, S., Ghosh, D.C., Sounda, G. and Jana, P.K. (2001).** Performance of intercropping legume in finger millet at varying fertility level. *Indian J. Agron.*, **46**(1): 38-44.
- More, V.G. (1990).** Study of intercropping of some oilseed and pulse crop in *khari*f finger millet (*Eleusine coracana* G.) under high rainfall condition of Konkan. M.Sc. (Ag.) Thesis, Dr. B.S. Kokan Krishi Vidyapeeth, Dapoli, (M.S.).
- Sharma, Akhilesh, Sharma, J.J., Rana, M.C. and Sood, Sonia (2006).** Evaluation of *Phaseolus vulgaris* as intercrop with vegetable for enhancing productivity system and profitability under high hill dry temperate condition of North-Western Himalayas. *Indian J. agric. Sci.*, **76**(1): 29-32.
- Shivakumar, B.G. and Yadahalli, Y.H. (1995).** Economics of intercropping in finger millet under late sown dry land conditions. *Farming Systems*, **11**(1-2): 1-7.
- Wiley, R.W., Natarajan, M., Reddy, M.S. and Rao, M.R. (1985).** Cropping system with groundnut, resources use and productivity. In : *Agril. Meteorology of Groundnut*. Proceeding of an International symposium, International Crop Research Institute for Semi-Arid Tropics, Sahelian Centre, 21-26 August, 1985, Patnencheru, Andhra Pradesh, India.

---

Received : November, 2008; Accepted : February, 2009