Journal of Crop and Weed, 13(3): 69-72 (2017)

Intercropping system in grain amaranth for higher productivity and profitability

J. S. ARUN KUMAR AND N. MURTHY

University of Agricultural Sciences, GKVK, Bengaluru – 560 065

Received : 12-12-2016 ; Revised : 19-11-2017 ; Accepted : 21-11-2017

ABSTRACT

Different inter crops were studied keeping grain amaranth as main crop to harness the nutritional benefit of grain amaranth as well as better intercropping system to achieve higher productivity and profitability. Grain amaranth when grown as sole crop, the B:C ratio was higher (3.15) as compared to all other treatments involving sole crops or intercrops. Considering the market nature for grain amaranth, it may not be ideal to grow grain amaranth as a sole crop alone. Hence the main objective was to introduce and popularize grain amaranth cultivation through other crops as intercrop. Among the intercrop treatments, growing of grain amaranth + pigeonpea (2:1) recorded higher B:C ratio of 2.75 with LER of 1.17, which was followed by grain amaranth + finger millet (2:8) with B:C ratio of 2.60 with LER of 1.19 and grain amaranth + groundnut B:C ratio (2.44) with LER of 1.22.

Keywords : Finger millet, grain amaranth, groundnut, intercrop, pigeonpea

Grain amaranth is a potential underutilized crop known for its nutritive grain. In the recent past, it has emerged as one of the important health care crop because of its high protein and minerals in the grain with high lysine content in the protein. Though, it is considered as crop of food and nutritional security, its cultivation is very limited both at global and national level and its full potential has not been exploited. For any underutilized potential crop species, the first step is to popularize the crop with farmers, creating market potential and to create awareness with the consumers about the nutritional benefits of crop. As there is limited market for grain amaranth, this crop cannot be promoted as pure or sole crop alone in the initial stage. Hence, such underutilized crops like grain amaranth needs to be grown in a popular existing cropping system. In this context, present study on intercropping grain amaranth with other crops of regional importance was carried out to evaluate the suitability of grain amaranth as intercrop in regular cropping system.

MATERIALS AND METHODS

The experiment was conducted at Main Research Station, University of Agricultural Sciences, Hebbal, Bengaluru, India for two consecutive *kharif* seasons. The experimental site is situated at an altitude of 12^0 58' North, longitude of 77^0 35' East and altitude of 899 meters above mean sea level. The normal annual rainfall is 862.95mm. The soil type is sandy loam with a pH of 6.55, Electrical conductivity of 0.26 dS m^{-1},organic carbon 0.62 per cent available N 236, P_2O_5 27.2 and 176.2 kg ha^{-1}. The experiment was laid out in Randomized Block Design with 10 treatments replicated thrice. Among the treatments, grain amaranth, pigeonpea, groundnut and finger millet were grown as a sole crops. The different intercropping combinations tried were grain amaranth + piegonpea (2:1), grain amaranth + groundnut (2:4), grain amaranth + finger millet (2:4), grain amaranth + pigeonpea (2:2), grain amaranth + groundnut (2:8) and grain amaranth + finger millet (2:8). The varieties used were grain amaranth (Suvarna), pigeonpea, (BRG-2), groundnut (TMV-2) and finger millet (GPU-28). The crop was grown under protective irrigation. The recommended dose of fertilizer was applied to respective crop when they were sown alone. While under the treatment of intercropping recommended dose of fertilizer (60N 40$P_2O_5$20 K_2O kg ha^{-1}) was given to grain amaranth crop. At the time of sowing 50 per cent of N was applied with full dose of $P_2O_5$and K_2O and remaining N was top dressed at 30 DAS. Necessary plant protection measures were taken to protect the crop from pests and diseases. The land equivalent ratio was calculated by using the formula:

$$\text{Land equivalent ratio (LER)} = \frac{Yab}{Yaa} + \frac{Yba}{Ybb}$$

Where yab and y_{ba} are individual crop yeild in intercropping and y_{aa} and y_{bb} are their yields as sole crop.

Economics of various treatments was worked out considering the prevailing market price of concerned crop and the grain equivalent yield of grain amaranth was calculated.

RESULTS AND DISCUSSION

Grain yield

The pooled results of different cropping system with regard to yield, LER and Economics comprising grain amaranth equivalent yield, gross returns, net returns and B:C ratio are presented in the tables 1-3. Sole crop of grain amaranth significantly recorded maximum grain

Email: arungowda63@gmail.com

Table 1: Grain/seed yield of grain amaranth and intercrops over the years

Sl.No	Treatments	Grain / seed yield (kg. ha^{-1})					
		2009-10		2010-11		Pooled Mean	
		Grain amaranth	Intercrop	Grain amaranth	Intercrop	Grain amaranth	Intercrop
1	Amaranth Sole Crop	1076	-	1262	-	1169	-
2	Pigeon pea Sole Crop	-	228	-	963	-	595.50
3	Groundnut Sole Crop	-	1104	-	1012	-	1058.33
4	Ragi Sole Crop	-	2812	-	3070	-	2940.33
5	Amaranth + Pigeon pea (2:1)	844	082	995	346	921.00	214.00
6	Amaranth + Groundnut (2:4)	381	892	515	887	447.83	889.67
7	Amaranth + Ragi (2:4)	247	2423	305	2536	276.17	2479.50
8	Amaranth + Pigeon pea (2:2)	628	096	723	405	675.33	250.67
9	Amaranth + Groundnut (2:8)	310	905	356	829	332.83	866.83
10	Amaranth + Ragi (2:8)	326	2496	390	2725	357.83	2610.67
SEm(±)		**63.33**	**96.20**	**42.48**	**100.62**	**62.66**	**67.76**
LSD (0.05)		**195.19**	**288.42**	**130.89**	**301.69**	**182.16**	**194.69**
CV (%)		**20.15**	**13.59**	**11.35**	**12.28**	**25.74**	**12.55**

Table 2: Land equivalent ratio (LER) and grain amaranth equivalent yield over the years

Sl.No	Treatments	LER			Grain amaranth equivalent yield (kg. ha^{-1})		
		2009-10	2010-11	Pooled mean	2009-10	2010-11	Pooled mean
1	Amaranth Sole Crop	1.0	1.0	1.0	1076.0	1262.0	1169.0
2	Pigeon pea Sole Crop	1.0	1.0	1.0	196.0	963.0	579.0
3	Groundnut Sole Crop	1.0	1.0	1.0	694.0	1012.0	853.0
4	Ragi Sole Crop	1.0	1.0	1.0	803.0	877.0	841.0
5	Amaranth + Pigeon pea (2:1)	1.18	1.16	1.17	914.0	1341.0	1128.0
6	Amaranth + Groundnut (2:4)	1.15	1.28	1.22	942.0	1402.0	1172.0
7	Amaranth + Ragi (2:4)	1.10	1.06	1.08	940.0	1030.0	985.0
8	Amaranth + Pigeon pea (2:2)	1.04	0.99	1.02	710.0	1128.0	919.0
9	Amaranth + Groundnut (2:8)	1.11	1.09	1.10	878.0	1180.0	1032.0
10	Amaranth + Ragi (2:8)	1.18	1.19	1.19	1039.0	1169.0	1104.0
SEm(±)		**0.93**	**0.041**	**0.051**	**79.1**	**50.8**	**61.8**
LSD (0.05)		**0.275**	**0.121**	**0.147**	**235.1**	**151.0**	**177.1**
CV (%)		**14.90**	**6.55**	**11.67**	**16.7**	**7.74**	**15.5**

yield of 1169 kg ha^{-1} as compared to other grain amaranth based intercropping systems (Table 1). Among the intercrops studied, the grain yield was higher when they were grown as sole crop than the grain yield obtained in intercropping system. Thus, growing of pigeonpea, groundnut and finger millet as intercrop in grain amaranth caused significant reduction in grain / seed yield at different row proportion as compared to sole crop. Though growing sole crop may be advantage from the yield point, but considering the importance of agro-biodiversity and to harness the nutritional benefits of grain amaranth, through intercropping systems its always better to practice intercropping especially with underutilized crops like grain amaranth which needs promotion through intercropping system rather as sole crop.

LER differed significantly in intercropping systems. It was higher (1.22) in grain amaranth + groundnut (2:4 row proportion) and was on par with (LER 1.19) grain amaranth + finger millet (2:8), grain amaranth + pigeonpea 2:1 row proportion (LER 1.17).

Table 3: Grain amaranth equivalent yield, gross returns, net returns and B:C ratio

Sl.No	Treatments	Grain equivalent yield (kg. ha^{-1}) Pooled mean	Gross returns (Rs.)	Net returns (Rs.)	B:C ratio
1	Amaranth Sole Crop	1168.83	40,915	27,291	3.15
2	Pigeon pea Sole Crop	579.33	20,265	4,115	1.34
3	Groundnut Sole Crop	853.17	29,855	11,405	1.62
4	Ragi Sole Crop	841.00	29,400	14,150	1.93
5	Amaranth + Pigeon pea (2:1)	1127.50	39,463	25,121	2.75
6	Amaranth + Groundnut (2:4)	1171.83	41,020	24,241	2.44
7	Amaranth + Ragi (2:4)	984.67	34,458	19,812	2.35
8	Amaranth + Pigeon pea (2:2)	919.17	32,165	13,371	2.17
9	Amaranth + Groundnut (2:8)	1031.67	29,462	12,013	1.69
10	Amaranth + Ragi (2:8)	1104.00	38,640	23,791	2.60
SEm(±)		**61.88**	-	-	-
CD at 5%		**177.11**	-	-	-
CV (%)		**15.49**	-	-	-

The intercropping of grain amaranth + groundnut (2:4) significantly recorded higher grain amaranth equivalent yield (1171.83 kg ha^{-1}) which was on par with grain amaranth sole crop (1168.83 kgs ha^{-1}), grain amaranth + pigeonpea 2:1 row proportion (1127.50 kg ha^{-1}) and grain amaranth + finger millet (2:8) 1104 kg ha^{-1}. (Table 2).

Comparative economic analysis of intercropping system indicated that net returns/ha was higher in grain amaranth grown as a sole crop (INR 27,291) with B:C ratio of 3.15 followed by grain amaranth + pigeonpea 2:1 (INR 25,121 with B:C ratio 2.75) grain amaranth + groundnut 2:4 (INR 24,241with B:C ratio 2.44) and grain amaranth + finger millet 2:8 (INR 23,791 with B:C ratio 2.60) (Table 3).

Singh.*et al.* (2009) realized high yield advantage (LER 1.92) with sugarcane + amaranth 2:2 intercropping system followed by sugarcane + amaranth (1:1). Sugarcane + amaranth fertilized at 150% RDF fetched the highest net returns (Rs 78,135/ha) and B:C ratio of 3.14.

Introduction of nutritionally rich underutilized crop like grain amaranth can improve the agro-biodiversity which is of national and international concern and also the health value of the underutilized nutritional crop. Underutilized crops and intercrops in crop rotation as factors for increasing biodiversity underutilized crops shall help to increase resistance to plant diseases, predators, and helping us to produce food without synthetic pesticides. (Bavec and Bavec, 2006). Intercropping pigeonpea with maize consistently resulted in higher net benefits, marginal rate of returns and returns per naira investment than sole cropping, which helps to increase in household incomes and alternative farm enterprise with adoption intercropping systems Moses and Joseph, (2012).

Underutilized crops bring diversity into crop rotations and provide new possibilities for soil cultivation. Intercropping i.e. sowing two or more crops together represents a high valued strategy for long term sustainable plant production management, due to its many beneficial effects like effects on increasing diversity of cultivated crops and nitrogen fixations by legumes Bergkvist *et al.*, 2011, Hauggaard-Nielsen *et al.*, 2007, Lithourgidis *et al.*, 2011, Sun *et al.*, 2009. Intercropping of Soyabean in sunflower crops constitutes a feasible alternative to increase land productivity in conventional cropping systems Elba *et al.*, (2014). Intercropping of mungbean with pigeonpea recorded higher pigeonpea equivalent yield and also improved soil fertility than sowing of sole crops Jitendra *et al.*, (2013). Farmers and researchers carry out different cropping systems to increase productivity and sustainability by using different Cropping systems including intercropping of different annual crops, the concept of which is interpreted in the present study.

In the present study, the grain amaranth as sole crop recorded higher B:C ratio (3.15) with net returns of INR 27,291, considering the agro-biodiversity in intercropping system and nutritional importance of grain amaranth, growing of Grain amaranth + pigeonpea (2:1), grain amaranth + groundnut (2:4) and grain amaranth + finger millet (2:8) row proportions were found to be economical which may help to introduce and popularize the grain amaranth in different cropping systems than sole crop.

REFERENCES

Bavec F and Bavec M. 2006. *Organic Production and Use of Alternative crops*. Boca Raton, New York, London : Taylor & Francis: CRC Press.

Bergkvist, G. Stenberg M., Wetterlind J., Bath B and Elfstrand S. 2011. Clover cover crops under-sown in winter wheat increase yield of subsequent spring barley-Effect of N dose and companion grass. *Field Crops Res.*120 : 292-98.

Elba B. de la Fuentea, Susana A. Suárez, Adriana E. Lenardis and Santiago L. Poggio., 2014. Intercropping sunflower and soybean in intensive farming systems: Evaluating yield advantage and effect on weed and insect assemblages. *NJAS - Wageningen J. Life Sci.*, **70-71** : 47–52.

Hauggaard-Nielsen H., Jørnsgaard H. Kinane J and Steen Jensen E. 2007. Grain legume-cereal intercropping the practical application of diversity, competition and facilitation inarable and organic cropping system. *Renewable Agri. Food Systems*. **23 :** 3-12.

Jitendra Kumar Malik, Ravindra Singh, O.V.S. Thenua and Anil Kumar. 2013. Response of Pigeonpea (*Cajanus cajan*) + mungbean (*Phaseolus radiatus*) intercropping system to phosphorus and biofertilizers. *Legume Res*., **36** (4) : 323- 30.

Lithourgidis A. S., Vlachostergios D. N., Dordas C. A and Damalas C. A. 2011. Dry matter yield, nitrogen content, and competition in pea-cereal intercropping systems. *Euro. J. Agron*. **34 :** 278-94.

Moses O. Egbe and Joseph A. Idoko, 2012. Evaluation of pigeonpea genotypes for intercropping with maize and sorghum in Southern Guinea Savanna: Economic benefits. *Int. J. Agri. Forestry*., 2(1) : 108-14.

Singh A. K., MenhiLal, Pushpa Singh, Ishwar Singh and Yadav.D.V. 2009. System productivity and profitabilityof sugarcane (*Saccharum* spp. hybrid complex) + grain amaranth (*Amaranthus hypochondriacus*) intercropping system. *Indian J. Agron*., **54** (3): 296-300.

Sun Y. M., Zhang N. N., Wang E. T., Yuan H. L., Yang J. S. and Chen W. X. 2009. Influence of intercropping and intercropping plus rhizobial inoculation on microbial activity and community composition in rhizosphere of alfalfa (*Medicago sativa* L.) and Siberian wild rye (*Elymussibiricus* L.). *FEMS Microbiol. Ecol*. ; 7062-70.