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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 10 (3): 511-513, 2007
ISSN 1028-8880

Reciprocal Effect of Component Crops Grown in Mixed Culture

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Abstract: To investigate the reciprocal effect of crops grown together for improvement of total production, an experiment was conducted at the Arid Zone Research Institute Dera Ismail Khan. The leguminous crops of mung and guar were grown alone and in combination with sorghum in Randomized Complete Block Design (RCBD) with four replications. The results showed that the physiological growth, yield components and grain yield of the component crops were significantly affected by each other. Data on plant height, leaf area index, grain weight, pods/plant, grains/pod and grain yield of each specie evinced decreasing trend in mixed culture compared to sole crops. Despite reduction in grain yield of sorghum, mung and guar due to reciprocal effect on each other, the grain equivalent yield total was increased in either case. The profit of 6.49 and 6.28% was achieved with mung and guar compared to sole cropping of sorghum, respectively. These findings suggest that the over all agricultural productivity can be increased through mixed cropping and efficient use of land resources in Pakistan.

Key words: Sorghum, mung, guar, mixed cropping, grain yield

INTRODUCTION

In Pakistan, the population growth rate at 2.10% annually (Government of Pakistan, 2003) is threatening all kind of natural resources including agricultural land. Numerous factors like urbanization, industrialization and mismanagement of natural resources erode the productive land and reduce the agricultural production. Increasing population and food deficit have necessitated developing agricultural technologies and increasing the crop production. In this scenario, efficient utilization of land resources can guarantee better yields and thus to food security and poverty alleviation.

Intensive cropping of two or more crops particularly differing in height, canopy and growth habits can exploit the land resources efficiently. Legumes grown with cereals increases total productivity as equivalent yields, improve soil fertility and add a considerable portion of proteins in human diet and animal feed (Anonymous, 1990). Singh and Balyan (2000) observed that legumes intercropping significantly increased the total productivity (sorghum equivalent yield) over sole crop yield of sorghum. Similarly, Goswami *et al.* (1999) concluded that the intercropping of soybean: sorghum (2:2) gave highest equivalent yield compared to sole yield of either crop. Ayisi *et al.* (2001) indicated that the overall land use efficiency assessed by the Land Equivalent Ratio (LER) was improved by an 11% with sorghum-cowpea combination. Karikari *et al.* (1999) assessed grain yield advantage of ground nut combination with pearl millet, sorghum and maize. They obtained yield advantage of 8.0, 9.22 and 67% with ground nut, respectively. Obuo *et al.* (1998) also reported higher yield advantage of cowpea-sorghum combination wherein highest Land Equivalent Ratio (LER) was 1.76 compared to sole crop. The present study aimed to evaluate the reciprocal effect on growth and yield advantage of cereal legumes combination in the climatic conditions of D.I. Khan.

MATERIALS AND METHODS

To study the reciprocal effect of companion crops and grain yield advantage, an experiment was undertaken at Arid Zone Research Institute D.I. Khan. The trial conducted on three different crops (sorghum, mung and guara) was laid out according to the Randomized Complete Block Design (RCBD) with four replications. Sowing of all the three crops alone and in combination was done on the same day in a well prepared seed bed. A basal dose of 60 kg ha^{-1} phosphorus was applied to the field uniformly, wherein 90 kg ha^{-1} N to sorghum and 20 kg ha^{-1} N to mung and guar crop was applied before sowing. The fertilizer Single Super Phosphate (SSP) and urea were the sources of P and N, respectively. All other cultural practices like weeding etc were kept uniform during the growing season.

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The growth performance of the companion crops was observed during the study. Sample of each crop were harvested for grain yield according to its physiological maturity. Computer software programme (MSU., 1988) was used to analyze the data recorded on growth characteristics and grain yield of the crops under study.

RESULTS AND DISCUSSION

Legumes effect on the growth of sorghum: The data depicted in Table 1 indicated that the growth and yield of sorghum were significantly affected by the legumes combination. Plant height, Leaf Area Index (LAI), grain weight/panicle and grain yield of sorghum were significantly reduced by mung and guar compared to sole sorghum. Sorghum plant height of 139.5 and 137.4 cm, Leaf Area Index (LAI) of 4.95 and 4.90 and grain weight/panicle of 66.52 and 65.32 g obtained with mung and guar, were significantly lower than the plant height of 149.9 cm, Leaf Area Index of 5.02 and grain weight/panicle 68.13 g of sole sorghum, respectively. This reduction in sorghum characters might be the result of competition for inputs like moisture and nutrients etc. which ultimately had reduced the growth parameters of sorghum.

The grain yield of sorghum obtained with mung and guar was 4 and 7% low than the grain yield 5840 kg ha^{-1} of sole sorghum, respectively. This decrease in grain yield of sorghum might be attributed to the reduction in yield components affected by mung and guar combination. These results were supported by Malik *et al.* (2002) who reported that the combination of lentil and lathyries reduced the grain yield of wheat by 11.76 and 12.74%, respectively.

Sorghum effect on the growth of legumes: The growth parameters like plant height, number of pods/plant and number of grains/pod of legumes were significantly affected by the sorghum. (Table 2). The plant height of mung (53.79 cm) and guar (77.165 cm) obtained in the sorghum associated culture was significantly low than their respective plant height of sole crops. The data further showed that the number of grain/pod of mung in case of mung + sorghum was significantly low than the sole crop of mung. Similarly, the guar pods (32.43)/plant and grains (6.58)/pod in case of guar + sorghum was significantly low than the sole crop of guar. Akhtar (1993) reported similar effect on the yield components of intercropped mash by maize.

The grain yield data in Table 2 showed that the grain yield (387 kg ha^{-1}) of mung was significantly reduced by sorghum than its sole yield of 723 kg ha^{-1}. The grain yield of guar was also reduced from 782 to 404 kg ha^{-1} by sorghum. This reduction in grain yield of mung and guar was 87 and 93% by sorghum, respectively compared to their sole crop yields. These findings suggest that due to competition for available resources to plants and reciprocal effect, the yield of components crops have adversely affected. These results are in line with the work of Kavamahanga *et al.* (1996) who found that the yields of intercropped soybean and common beans were 90 and 68% of their respective sole plantings.

Table 1: Effect of legumes on the growth and yield of sorghum

Parameters	Plant height (cm)	Leaf area index	Grain weight/panicle (g)	Grain yield (kg ha^{-1})
Sorghum alone	146.9^{a}	5.02^{a}	68.13^{a}	5840^{a}
Sorghum + mungbean	139.5^{b}	4.95^{b}	55.62^{b}	5620^{b}
Sorghum + guar	137.4^{c}	4.90^{c}	65.32^{c}	5450^{c}
LSD	1.312	0.042	1.030	69

Values followed by similar letter(s) do not differ significantly

Table 2: Effect of sorghum on the growth and yield of legumes

Parameters	Plant height (cm)	No. of pods/plant	No. of grains/pods	Grain yield (kg ha^{-1})
Mung alone	56.25^{c}	11.00^{c}	10.75^{a}	723^{a}
Mung + Sorghum	53.79^{d}	10.50^{c}	9.50^{b}	387^{b}
Guar alone	78.95^{a}	36.50^{a}	8.00^{c}	782^{a}
Guar + sorghum	77.16^{b}	32.42^{b}	6.58^{d}	404^{b}
LSD	0.665	2.627	0.813	95

Values followed by similar letter(s) do not differ significantly

Table 3: Grain equivalent yield data

Crop	Grain yield	Grain equivalent yield	Increase (Profit) (%)
Sorghum	5840	-	-
Mung	723	-	-
Guar	782	-	-
Sorghum + mung	-	6394	9.49
Sorghum + guar	-	6027	6.28

Grain equivalent yield: The data indicated that due to reciprocal effects the yield components and grain yield of the component crops were decreased than their respective yields in sole crops. But the grain equivalent yield of sorghum 6394 and 6207 kg ha^{-1} with mung and guar, respectively was 9.49 and 6.28% more than the sole grain yield of sorghum (Table 3). This showed that the overall productivity in mixed cropping was more than the sole crop of either specie. These results are in line with the work of Abbas *et al.* (1995) and Goswami *et al.* (1999).

The results of this study showed that on the basis of overall productivity, the land use efficiency can be improved by growing of two or more crops together. However the component crop requirements (input like nutrients etc.), planting pattern and growth habits should be considered to get potential yield of the component crops and increase total productivity.

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