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Effect of different levels of irrigation, cropping systems and *Rhizobium* inoculation on growth and yield of groundnut and sesame

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A field experiment was conducted at C-Block farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal during summer season of 2003 to study the effect of different levels of irrigation, cropping systems and *Rhizobium* inoculum on growth and yield of groundnut and sesame Groundnut seeds were bacterised by *Rhizobium*-culture G-90 to study the nodulation. Irrigation influenced significantly the plant height of both the crops and nodule number in groundnut. But it had no significant effect on nodule dry weight and yield components. In general, two irrigations level was found superior to the other irrigation treatments and recorded highest pod and seed yield of groundnut and sesame respectively. Regarding combined yield, sole crop of groundnut gave rise to the highest pod yield followed by the intercrop groundnut + sesame (3:1). Both the intercropping system were advantageous and combination groundnut + sesame (3:1) was the best under three irrigations.

Key words : Nodule, *Rhizobium*, inoculation, nodulation, groundnut, sesame

INTRODUCTION

The picture of oilseed production was very poor before 1986 both in terms of acreage and production. It is only after the establishment of technology mission on oilseeds (TMO) by the centre in 1986 the grain scenario took hopeful turn. The average annual oilseed production in four years (1987-91) after the establishment of TMO, had risen to 16.7 million tones in comparison to 12 million tones in the preceeding four years, a record annual 10 per cent increase. So, the future of Indian Agriculture depends on increase in productivity and stabilization of yield through breeding more productive varieties, judicious fertilizer use including bacterial fertilizer, weed and pest control and maximisation of efficiency of irrigation. For this purpose intercropping has a great role as intecropping is a potentially beneficial system of crop production which is due to yield advantage and yield stability. Research works, carried out earlier, have revealed that a possible means of increasing productivity of lands with limited resource is through intercropping (Baker 1974 : Chatterjee and Mandal 1992). Intercropping has long been recognised as a very common practice throughout the developing tropics. It is one of the means of stabilizing yield and the most important in its favour is the miminisation of risk of crop failure in dry land (Sharma and Singh 1987). Intercropping may be defined as growing of two or more crops simultaneously for a significant part of their growing periods (Willey 1979).

In the present investigation, intercropping of groundnut (seed bacterisation with *Rhizobium* culture) and sesame under different levels of irrigation on the basis of physiological growth stages of groundnut was conducted to study the different competition functions and to find out the yield advantage due to *Rhizobium* inoculation of groundnut seeds and intercropping with sesame.

MATERIALS AND METHODS

The field investigation was carried out at seed farm under B.C.K.V., Kalyani, Nadia, to study the effect of levels of irrigation, different cropping systems and *Rhizobium* inoculation on the growth and yield of groundnut and sesame, during the summer season of 2003. There are 3 levels of irrigation, one level of *Rhizobium* culture and 6 levels of cropping systems. Fitting in a split plot design with the plot size 3 m × 2 m the different levels on irrigation were allotted in main plots and different levels of cropping system in subplots.

Three levels of irrigation were given in the main plots i.e. I_1 = one irrigation at flowering, I_2 = Two irrigation – one at flowering and other at pod development, I_3 = Three irrigations given each at branching, flowering and pod development.

Six different types of cropping systems were allotted to subplots i.e. T_1 = sole groundnut, T_2 = sole sesame, T_3 = groundnut : Sesame (3:1), T_4 = groundnut : sesame (1:3), T_5 = groundnut : Follow (3:F), T_6 = sesame : foliar (3:F). *Rhizobium* inoculation on groundnut was done by seed bacterisation method at the time of sowing seed in the field. Fertilizer application were done on groundnut crop @ 20 Kg, N : 20 Kg, P_2O_5 : 25 kg, K_{20} per ha and for sesame 30 kg, N : 20 kg P_2O_5 : 25 kg, K_2O per ha. The experimental field was situated on high land with assured irrigation. The soil of the field is silty loam with good drainage condition.

RESULTS AND DISCUSSION

Effect of different levels of irrigation cropping system and *Rhizobium* inoculation on nodulation of groundnut plant

Both the highest number of nodules per plant (Table 1) and dry weight of nodule per groundnut plant (Table 2) were observed with two irrigation at all observations. But irrigation, in general, did not significantly influenced both the nodule number and nodule weight per plant except the observation at 75 days after sowing where two irrigations produced significantly higher number of nodules per plant over one irrigation (Table 1).

In general, cropping systems did not significantly influenced both the number of nodules of dry weight of nodules per groundnut plant except the

Table 1 : Effect of levels of irrigation and cropping system on nodule number of groundnut (with *Rhizobium* inoculation) per plant.

Levels of irrigation	60 DAS Cropping System				75 DAS Cropping System			
	Sole G	G+S (3:1)	G+S (1:3)	G (3:F)	Sole G	G+S (3:1)	G+S (1:3)	G (3:F)
One	121.66	89.33	95.66	96.33	145.00	140.33	141.66	145.66
Two	121.66	116.66	112.66	110.00	169.33	160.33	162.33	166.66
Three	114.33	106.66	113.33	106.00	164.00	162.33	155.88	156.11
CD at 5%	N.S.	8.79	N.S.	N.S.	18.95	N.S.	N.S.	N.S.

DAS = Days after sowing ; N.S. = Not Significant
G = Groundnut ; S = Sesame ; F = Fallow

Table 2 : Effect of levels of irrigation and cropping system on dry weight of nodules (mg) per plant groundnut (with *Rhizobium* inoculation)

Levels of irrigation	60 DAS Cropping System				75 DAS Cropping System			
	Sole G	G+S (3:1)	G+S (1:3)	G (3:F)	Sole G	G+S (3:1)	G+S (1:3)	G (3:F)
One	242.67	204.66	201.00	240.00	350.33	344.66	337.00	343.00
Two	243.33	252.66	247.33	227.33	349.66	353.33	341.66	351.33
Three	252.66	240.33	247.33	244.00	350.00	338.00	347.88	343.33
CD at 5%	N.S.	N.S.	N.S.	N.S.	18.94	N.S.	N.S.	N.S.

DAS = Days after sowing ; N.S. = Not Significant
G = Groundnut ; S = Sesame ; F = Fallow

observation at 60 days after sowing (Table 2) where sole groundnut produced significantly higher number of nodules per plant over all other cropping systems. Sole crop of groundnut produced both highest number of nodules and highest dry weight of nodules per plant in all the observations followed by the cropping system in which three rows of groundnut were alternated with one row of sesame or fallow. Intercrop plants produced both less number of nodules and less dry weight of nodules per plant than sole crop. Similar observation was also made by Mandal *et al.* (1991).

This indicated that shading by sesame plant resulted a decrease in nodulation. Another probable reason of reduced nodulation in intercrops might be due to the effect of interspecific competition between the roots of groundnut and intercropped sesame plants. Mandal *et al.* (1991) opined alike. There was no significant interaction effect of irrigation and cropping system on number and dry weight of nodules per groundnut plant.

Effect of different levels of irrigation and cropping system on height of groundnut (with *Rhizobium* inoculation) and sesame plants

Height of groundnut plants

Observation was taken on 75 days of sowing data presented in Table 3 showed that irrigation was found to significantly influence height of groundnut plants and highest plant height was obtained with two irrigations. Cropping system significantly influenced the plant height. It was also found that association of groundnut and sesame brought an increase towards the plant height. Interaction between irrigation and cropping systems was not found to significantly influence the height of plants.

Height of sesame plants

Highest plant height of sesame was found with two irrigations (Table 3). Cropping system significantly influenced the plant height and sesame plant height was depressed when one row of sesame was grown with 3 three rows of groundnut. But highest plant height was recorded with the intercropping system groundnut plus sesame (1:3). Effect of interaction between levels of irrigation and cropping systems was also statistically significant.

Effect of levels of irrigation, cropping system and *Rhizobium* inoculation on pod yield (kg/ha) of groundnut.

Different cropping systems had significant influence on pod yield of groundnut. Sole crop of groundnut produced significantly higher yield over other treatments (Table 4). Similar observations were made by Samui *et al.* (1992). The lowest pod yield was recorded when 3 rows of groundnut were alternated with one row of fallow. Selvan *et al.* (1990) opined alike. The yield with the G (3:F) treatment was less than expected. But the intercropped groundnut produced expected yield as in the case of G+S (3:1) treatment or 22% more than expected as in the case of G+S (1:3) treatment Yamada *et al.* 1986.

The interaction between the levels of irrigation and

Table 3 : Effect of levels of irrigation and cropping system on height (cm) of groundnut (with *Rhizobium* inoculation) plant and sesame at 75 DAS.

Levels of irrigation	60 DAS Cropping System				75 DAS Cropping System			
	Sole G	G+S (3:1)	G+S (1:3)	G (3:F)	Sole G	G+S (3:1)	G+S (1:3)	G (3:F)
One	46.66	43.66	46.33	44.33	63.33	57.33	68.66	70.33
Two	49.00	50.66	50.33	47.33	80.66	74.00	83.33	67.33
Three	45.33	46.00	48.44	46.00	76.33	68.00	72.00	77.66
CD at 5%	2.93	2.34	N.S.	4.54	7.23	5.90	10.22	11.33

DAS = Days after sowing ; N.S. = Not Significant
G = Groundnut ; S = Sesame ; F = Fallow

cropping systems had a significant effect on pod yield of groundnut (Table 4). The highest yield was obtained with sloe crop of groundnut at two irrigations level.

Table 4 : Effect of levels of irrigation and cropping system on pod yield (kg/ha) of groundnut (with *Rhixobium* inoculation)

Levels of irrigation	Cropping System			
	Sole G	G+S (3:1)	G+S (1:3)	G (3:F)
One	1596.33	1166.66	480.00	1153.00
Two	1761.66	1335.66	550.00	1176.66
Three	1666.66	1270.00	510.00	1172.00
CD at 5%	69.11	31.39	54.39	82.69

DAS = Days after sowing ; G = Groundnut ; S = Sesame ; F = Fallow

Effect of levels of irrigation and cropping system on seed yield of sesame

Effect of intercropping on seed yield of sesame was found to be significant (Table 5). Sole crop of sesame produced the highest seed yield which significantly out yielded all other intercropping treatments (Table 5). The lowest yield was recorded from G+S (3:1) treatment and it was significantly lower than yields obtained from other treatments. The treatments G+S (1:3) produced significantly higher seed yields. But the reduced yield was more than expected on the basis of planted area. For example in the G+S (3:1) treatment more than 9% of the sole sesame crop was realized. But in case of S (3:F) treatment, where a row was kept fallow, the reduction was more than expected. This indicates in importance of transfer of nitrogen as reported by Virtanen (1937) when pulses are grown with oil seeds together. Similar effects of intercropping was observed by Samui *et al.* (1992).

Table 5 : Effect of levels of irrigation and cropping system on seed yield (kg/ha) of sesame

Levels of irrigation	Cropping System			
	Sole G	G+S (3:1)	G+S (1:3)	G (3:F)
One	703.66	201.00	549.00	539.66
Two	966.66	250.00	710.00	537.00
Three	868.00	236.00	650.00	556.00
CD at 5%	80.03	52.92	91.66	111.67

DAS = Days after sowing ; G = Groundnut ; S = Sesame ; F = Fallow

The interaction between irrigation and cropping systems also influenced the seed yield of sesame at two level of irrigation recorded at highest seed yield where as the lowest seed yield was observed with the treatment G+S (3:1) at one level of irrigation.

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