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Studies on inter-cropping green manures with grain legumes in the pre-rice season and its effect on rice

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Abstract : Field investigations were carried out to assess the possibility of including green manure crops with grain legumes in the pre-rice season and to study their effect on the succeeding rice. Two green manures, *Sesbania aculeata* and *Sesbania rostrata* were inter-cropped with greengram and redgram and incorporated to the follow up rice crop treated with three levels of N viz., 0, 50 and 100 kg N ha^{-1}. Results indicated that loss in yield of grain legumes due to intercropping was well compensated by the green manure contribution to the succeeding rice. Rice yield obtained with incorporation of *S. rostrata* and redgram with 50 kg N ha^{-1} was higher than that obtained with 100 kg N ha^{-1} alone thus resulting in a saving of 50 kg of fertiliser N ha^{-1}. *(Key Words : Grain legumes, Green manures, Succeeding rice, N levels)*

To minimise the dependence on non renewable sources of energy and also to sustain soil productivity, attention is now focussed on alternate sources of N. In this context, green manures are gaining popularity. The capital, time and labour involved in raising a green manure can be reduced if it is suitably included in the pre-rice season during which a grain legume is normally grown. By inter-cropping in suitable proportions, the green manures and grain legumes can be utilised as a source of grain, fodder and biological nitrogen. According to Bhagat *et al.*, (1988) application of 50 per cent of the total N as S. *aculeata* and remaining N as urea gave higher rice yields and resulted in lower losses of ammoniacal and nitrate N. Becker *et al.* (1988) reported that ratooned sesbania showed faster growth than seeded plants. By growing green manure in the off-season, leaching loss of N and other nutrients could be reduced and the green manure crop could use forms of phosphorus and zinc less available to rice and increase their availability. Enhanced availability of micronutrients like iron due to green manure incorporation was also reported by Takkar and Nayyar (1986).

Materials and Methods

Experiments were conducted in the Wetland Farm of Tamil Nadu Agricultural University during summer (February-June) and kharif (July-October) seasons. The soil of the experimental field was black clayey in nature, classified taxonomically as Vertic Ustochrefit, low in available N, medium in available P and high in available K. The pre-rice crops including grain legumes viz., greengram *(Vigna radiata)* variety Co 4 and redgram *(Cajamus cajan)* variety ICPH 73, green manures *S. rostrata* and *S. aculeata* were raised in 3:1 proportion. Greengram was sown at a spacing of 30 x 10 cm as sole crop and 25 x 10 cm as inter-crop. Redgram was sown at 60 x 20 cm as sole crop and 45 x 20 cm as inter-crop. The green manure crops were sown at 30 x 15 cm as sole crop and 40 x 15 cm as inter-crops. The grain legume and green manure treatments were laid out in a randomised block design and replicated thrice. The succeeding rice crop (var. CR 1009) was raised in split plot design and replicated thrice with the eight treatment combinations of grain legumes and green manures in main plots and three levels of N (0, 50 and 100 kg ha^{-1}) in the sub plots. The green manures were cut as a height of 30 cm from the ground on 45 DAS for fodder and ratooned. The biomass of the ratoon crop was incorporated. In case of grain legumes, the pods were harvested and the haulms of greengram were removed for fodder

while redgram haulms were incorporated as green manure for the succeeding rice. All the crop management practices were followed as per the recommendations in the Crop Production Guide. Biometric observations and yield were recorded at different stages of crop growth for pre-rice crops and rice. Soil nutrient status at pre and post harvest stages were also recorded.

Results and Discussion

Results indicated that *S. aculeata* performed better as sown crop, but as ratoon crop, *S. rostrata* yielded higher biomass and contributed more N to rice. Combined use of sesbania and grain legumes yielded better results than the use of grain legume alone. Grain legumes yielded 364-401 kg ha^{-1} when inter-cropped with green manure crops. The green manure crops gave 14-17 t ha^{-1} as fodder and their ratoon regrowth contributed 5.2-8.6 t ha^{-1} biomass as green manure. Incorporation of haulms of redgram and ratooned green manure plants contributed 20-65 kg N ha^{-1} and increased rice grain yield by 20-30 per cent over no green manure (Table 1).

Yields obtained with incorporation of sole *Sesbania spp.* and 50 kg N ha^{-1} was comparable with sole application of 100 kg N ha^{-1} resulting in a saving of 50 kg N ha^{-1} (Table 2). Combined application of green manures and fertiliser N would be more beneficial than their individual application even on equal nutrient basis (Ventura *et al.* 1987). Results of the present study shows that rice yields after green manures with sole *Sesbania spp.* (4.5 t ha^{-1}) without fertiliser N was comparable with yields obtained with 50 kg fertiliser N ha^{-1} alone (4.7 t ha^{-1}). This is in conformity with the earlier findings of Meelu and Morris (1986) and Abrol and Palaniappan (1988). In the context of including a green manure without loosing the grain legume crop, inter-cropping *Sesbania spp.* with redgram and with application of 100 kg N ha^{-1} for rice was the best option.

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Table 1. Biomass production and yield of grain legumes and green manures

Treatments	Grain yield (kg ha^{-1})	Biomass removed for fodder(t ha^{-1})	Biomass incorporated (t ha^{-1})	N contrbution (kg ha^{-1})
Sole GG	515	9.4	-	-
Sole RG	783	8.1	3.6	20.8
Sole SA	-	27.2	15.9	80.1
Sole SR	-	29.9	19.7	99.3
GG + SA	364	16.8	5.2	29.3
GG + SR	338	17.4	5.3	41.7
RG + SA	401	14.3	7.9	58.0
RG + SR	373	14.9	8.6	64.6
CD (p=0.05)	-	0.5	0.6	0.8

GG - Green gram RG - Red gram SA - S.aculeata SR - S. rostrata

Table 2. Grain yield of rice (t ha^{-1})

Treatments	N_0	N_{50}	N_{100}	Mean
Sole GG	3.08	4.78	5.29	4.38
Sole RG	3.43	5.13	5.80	4.79
Sole SA	4.46	6.12	6.76	5.78
Sole SR	4.49	6.21	6.78	5.83
GG + SA	3.62	5.39	6.15	5.05
GG + SR	3.77	5.48	6.12	5.13
RG + SA	4.09	5.78	6.30	5.39
RG + SR	4.20	5.80	6.42	5.47
CD (p=0.05)	4.02	5.58	6.20	--

	SEd	CD(0=0.05)
T	0.17	0.36
N	0.10	0.21
T at N	0.29	0.61
N at T	0.30	0.61

GG - Greengram
RG - Redgram
SA - S.aculeata
SR - S. rostrata

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Studies on intercropping in winter irrigated cotton

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Abstract : Field experiments were conducted during 1994-95 and 1995-96 at the Cotton Breeding Station, Tamil Nadu Agricultural University, Coimbatore to study the suitable intercrops (cowpea, blackgram, greengram and soybean) for winter irrigated cotton (MCU.5). The intercrops were sown on two dates viz., 20 days in advance and sown simultaneously with cotton. Soybean (Co. 2) recorded the highest grain yield (1483 kg/ha) when sown 20 days in advance to cotton followed by cowpea (Co. 6). When intercrops were sown simultaneously, cowpea recorded the highest grain yield (1108 kg/ha) followed by soybean (1099 kg/ha). Under both advance and simultaneous sowing, blackgram (Co. 5) and greengram (Co. 5) recorded lesser grain yield than soybean and cowpea. The kapas yield of cotton was reduced drastically by soybean compared to that of sole of cotton. The intercrops viz., cowpea, blackgram and greengram increased the kapas yield compared to that of sole of cotton, when they were sown in advance. When sown simultaneously with cotton, the seed cotton yield was increased by cowpea and blackgram. Based on net return and benefit cost ratio, cowpea was found to be the best suited intercrop for MCU.5 cotton.
(Key Words : Cotton, Cowpea, Blackgram, Greengram, Soybean, Intercrops)

Cotton is an important commercial fibre crop in India. In Tamil Nadu, the cotton area has come down from about 8.0 lakh hectares to 2.68 lakh hectares within two decades since 1970's. This is mainly due to increase in the cost of cultivation and also replacement of cotton by other crops. To make the cotton cualtivation economically viable, intercropping seems to be a viable proposition. Blackgram and greengram were found to have no adverse effects on cotton yields (Singh and Chauhan, 1981; Chellaiah, 1996). When blackgram was sown three weeks in advance to cotton, the growth and yield of cotton was increased (Robinson, 1973). Hence, the present investigation was contemplated to find out the suitable intercrop for winter irrigated cotton and to see their effect on cotton when sown 20 days in advance and sown simultaneously.

Materials and Methods

Field experiments were conducted for two years (1994-95 and 1995-96) at the Cotton Breeding Station, Tamil Nadu Agricultural University, Coimbatore with cotton (MCU.5) as main crop and cowpea (Co. 6), greengram (Co. 5), blackgram (C0.5) and soybean (Co.2) as intercrops. Intercrops were sown in two different dates viz., 20 days in advance to cotton (3.8.94 and 4.8.95) and sowing simultaneously (23.8.94 and 24.8.95) with cotton. Cotton was planted in normal rows with 75 x 30 cm spacing. One row of intercops were sown in between cotton rows. The intercrops viz., soybean, greengram and blackgram were sown with an intrarow spacing of 10cm while cowpea was sown with 15 cm. The trial was laid out in RBD with three replications. The soil type of the experimental field was clay loam with low available N (303 kg/ha), medium P (20 kg/ha) and high K (603 g/ha). The soil pH was 7.4 with an EC of 0.4 dSm^{-1}. The crops were raised under irrigated condition. The different intercrops were harvested after pod