Regarding the number of branches and number of nodes per plant in poly greenhouses they were higher (114.20 and 19.37) than that of open field. Picking of fruits started from after 9 weeks of transplanting in the poly greenhouse, while in the control plot first yield was collected on 9½ weeks after. This delay of 5 days was due to slow rate of growth and the incidence of disease in the outside crop. A total of 9 pickings were made from poly-greenhouse (Table 2) and open field conditions where there was a difference of 2165 g fruits between the two.

From observations on biometric characters, it was found that the fresh weight of single plant from poly-greenhouse was (988.33 g) 2 times higher as compared to that in open field conditions (491.67 g). The average fruit weight from poly-greenhouse was 95.02 gms and average fruit diameter was 6.23 cm, whereas the average fruit weight was 84.40 gms and average fruit diameter was 5.71 cm from control plot.

The fruit yield (Table 2) from poly - greenhouse was 2985.97 per plant and that from open field was 819.94gms per plant. Therefore, the fruit yield from poly-greenhouse was 3½ times higher as compared to open field conditions.

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Effect of sowing time and intercropping on the yield of coriander under rainfed vertisol condition

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Abstract: Field experiments were conducted during rabi 1997-98 and 1999- 2000 at Regional Research Station Aruppukottai to find out the optimum time of sowing and suitable intercrops for coriander under rainfed vertisol condition. November first week was found to be the optimum time for the sowing of coriander sole crop where as October last week was for coriander intercropping system. Among the intercrops tested, onion was found suitable for intercropping with coriander under rainfed vertisol condition. November first week sown coriander sole crop had recorded higher yields, 143 and 103 kg/ba during 1997-98 and 1999-2000 respectively. During 1999-2000, October last week sown intercropping system had produced more coriander yield equivalent (498 kg ha^{-1}), higher gross income (Rs.7969/ha^{-1}) and net income (Rs.4837/ha^{-1}) with 2.31 and 1.109 as benefit- cost ratio and LER values. Among the intercropping systems followed, during 1999-2000, coriander + onion intercropping system in 1:1 ratio had recorded significantly the highest equivalent yield (871 kg ha^{-1}), more gross income (Rs.11939/ha^{-1}) and net income (Rs.9439/ha^{-1}) with a benefit cost ratio of 3.10. *(Key words: Coriander, Onion, Bengalgram, Karunganni cotton, Time of sowing, Intercroping, Coriander Equivalent Yield).*

Coriander, one the main spices crop in the vertisols of Southern Zone, is being cultivated during rabi in more than 18,350 hectares with annual production of 5,300 tonnes. The lower productivity in coriander is due to several constraints. Raising of coriander crop purely under rainfed situation is considered to be one of the constraints in coriander cultivation resulting reduction in yield to the tune of 30 to 75 per cent depending upon the quantum and distribution of North East

monsoon. Coriander is mainly grown as sole crop under rainfed condition. The yield of coriander gets affected during periods when monsoon rains are very low i.e. below 600 mm or very high i.e. above 1000 mm. With the help of North East monsoon, pearl millet, sunflower and coriander are being sown during second fort night of October or first fort night of November. The North East Monsoon rains are primarily cyclonic and take place when depression occurs in the Bay of Bengal. The date of onset of rains varies considerably and hence the rainy season cropping is more risky (Virmani, 1991). Under these situations to avoid a complete failure of coriander crop, farmers used to grow bengalgram and onion as intercrops. Karunganni cotton, a cotton variety that can be grown even under late situations is not so far tested as intercrop with coriander. Since the information of response of coriander to time of sowing and to various intercrops is meagre, a study to find out the optimum time of sowing for coriander and to select a suitable intercrop for base crop, coriander was initiated.

Materials and Methods

Field experiments were conducted during rabi 1997-98 and 1999-2000 at Regional Research Station Farm, Aruppukottai. The rainfall particulars are furnished in Annexure -1. The soil of the experimental field was clay loam in texture, low in available nitrogen (230 kg/ha^{-1}), medium in available phosphorus (12.5 kg ha^{-1}) and potassium (250 kg ha^{-1}). The pH of the experimental field was 8.2. The experiment was laid out in split plot design with three replications.

During 1997-98, the experiment consisted of two time of sowings i.e. D1- October second fortnight and D2- November first fortnight in main plots and five intercropping systems *viz.* S1 - Coriander - sole crop, S2 - Coriander + wheat, S3 - Coriander + bengalgram, S4 - Coriander + onion and S5 - Coriander + karunganni cotton in sub-plots. The component crops were sown in paired rows (15 cm in the pairs and 37.5 cm between pairs). In between paired rows of coriander, one row of intercrops of wheat, bengalgram, onion and karunganni cotton was sown. The sowings were taken up on 23.10.97 (D1) and 7.11.97(D2).

During 1999-2000, due to the failure of intercrop, wheat during 1997-98, the other intercrops namely bengalgram, onion and karunganni cotton were tested. The experiment consisted of three time of sowings i.e. D1 - October last week, D2 - November first week and D3 - November second week in main plots and seven intercropping

Table 1. Effect of time of sowing and intercropping on rainfed coriander (*Rabi* 1997-98).

Treatment	Plant height (cm)	No.of umbel/ plant	No.of capsule plant	100 seed weight (g)	Yield of crops					Coriander yield equivalent (kg ha^{-1})
					Base crop		Intercrops			
					Coriander	Wheat	Bengalgram	Onion	K.cotton	
Time of sowing										
D_1-October second fortnight	39.6	3.9	55.8	1.275	136.4	-	-	346.4	72.0	220
D_2-November first fortnight	37.8	4.6	79.9	1.234	142.8	-	-	641.8	9.8	283
CD (P = 0.05)										
Intercropping system										
S_1-Coriander-sole crop	37.5	4.2	66.5	1.206	145.5	-	-	-	-	145.5
S_2-Coriander + wheat	38.8	4.5	76.0	1.256	144.7		-	-	-	144.7
S_3-Coriander + bengalgram	38.2	4.8	80.0	1.326	155.4	-	-	-	-	155.5
S_4-Coriander +onion	38.1	4.3	63.7	1.180	106.0	-	-	494.1	-	600.0
S_5-Coriander + k.cotton	40.9	3.5	52.9	1.303	146.8	-	-	-	65.9	212.5
CD (P = 0.05)	N.S	0.66	12.47	0.0152	9.31	-	-	NA	NA	NA

Table 2. Effect of time of sowing and intercropping on rainfed coriander (*Rabi* 1999 - 2000).

Treatment	Plant height (cm)	No.of umbels/ plant	No.of capsules plant	100 seed weight (g)	Yield of crops: Base crop		Intercrops			Coriander yield equivalent (kg ha^{-1})
					Coriander	Wheat	Bengalgram	Onion	K.cotton	
Time of sowing										
D_1 - October last week	35.1	4.77	24.1	1.433	76.5	-	80.7	2592.0	754.0	498
D_2 - November first week	36.2	4.21	31.1	1.466	102.9	-	68.7	2629.0	423.7	459
D_3 - November second week	30.6	4.18	21.9	1.369	68.6	-	52.9	1683.4	137.2	267
CD (P = 0.05)	0.99	0.28	2.04	0.027	9.65	-	-	-	-	73.4
Intercropping system										
S_1 - Coriander + bengalgram (1:1)	33.9	4.99	27.1	1.492	60.3	-	73.2	-	-	152
S_2 – Coriander + bengalgram (2:1)	32.5	3.89	23.5	1.331	92.5	-	61.6	-	-	170
S_3 – Coriander + onion (1:1)	34.0	4.84	26.9	1.485	59.0	-	-	2599.3	-	871
S_4 – Coriander + onion (2:1)	32.8	3.90	20.8	1.357	83.1	-	-	2003.6	-	709
S_5 – Coriander + k. cotton (1:1)	34.2	4.92	29.2	1.531	67.6	-	-	-	474.7	424
S_6 – Coriander + k.Cotton (2:1)	34.5	3.57	21.8	1.425	94.2	-	-	-	401.9	396
S_7 - Coriander – sole crop	36.0	4.60	30.4	1.335	121.9	-	-	-	-	122
CD (P = 0.05)	1.52	0.28	1.42	0.037	5.75	-	-	-	-	44.9

systems, *viz.* S_1 - Coriander + bengalgram in 1:1 ratio, S_2 - Coriander + bengal gram in 2:1 ratio, S_3 - Coriander + onion in 1: J ratio, S_4 - Coriander + onion in 2:1 ratio, S_5 - Coriander + karunganni cotton in 1 -1 ratio, S_6 - Coriander + karunganni cotton in 2:1 and S_7 - Coriander -sole crop in sub plots. The sowings were taken up on 25.10.99 (D1), 1.11. 99 (D2) and 8.11.99 (D3).

In 1:1 ratio, coriander and intercrops were sown following replacement series, while in 2:1 ratio, coriander was sown in paired rows (15 cm in the pairs and 37.5 cm between pairs). In between paired rows of coriander, one row of intercrops of bengalgram, onion and karunganni cotton was sown. A uniform plant to plant spacing of 15 cm was adopted for coriander and for all intercrops. The recommended dose of NPK i.e. 20:45:0 kg ha^{-1} were applied for coriander alone in the form of urea (46 % N), single super phosphate (16% P_2O_5) and muriate of potash (60% $K_2 0$). Half dose of nitrogen and full dose of phosphorus were applied basally at the time of sowing. Remaining half dose of nitrogen was applied as top dressing at 30 DAS when thinning of plants was over.

During both the years, coriander Co3, wheat HW 1093, bengal gram Co 1, onion local and karunganni cotton K11 were used for this study. Pure crop of wheat, bengalgram, onion and karunganni cotton were raised during 1997-98, while during 1999-2000, bengalgram, onion and karunganni cotton alone were raised under non replicated plots.

The observations on growth parameters, yield and yield parameters of coriander were recorded at maturity. Yield of intercrops was also recorded at maturity. The data gathered were scrutinized as per Panse and Sukhatme (1995) to trace the level of significance.

Results and Discussion

Effect of time of sowing

Results revealed that the differences due to time of sowing on plant height of coriander were significant during 1999-2000 only (Table 2). Tallest plants (39.6 cm) were recorded on October second fortnight sowing during 1997 - 98 and thereafter the values decreased. During 1999 - 2000, November first week sown crop produced tallest plants (36.2 cm) and it was on par with the plant height of crop sown during October last week. Significant effect of time of sowing, during both the years, was observed in number of umbels/plant, number of capsules/ plant and 100 seed weight (Table 1 and 2). The

differences on grain yield due to time of sowing were significant in 1999-2000 only (Table 2). Grain yield of coriander reached maximum on November first fortnight sowing during 1997-98 and November first week sowing during 1999-2000. During 1997-98, highest yield of 142.8 kg ha^{-1} was recorded on November first fortnight sowing. However, coriander yield of October second fortnight (136.4 kg ha^{-1}) was at par with November first fortnight sowing (Table 1).

During 1999-2000, the mean coriander yield decreased rapidly when the sowing was taken one week earlier to November first week (or) postponed by one week beyond November first week as evidence by the meagre yield of 76.5 and 68.6 kg ha^{-1} for October last week and November second week sowing respectively and this decrease ranged from 34.5 (October last week) to 50.0 per cent (November second week) from that of November first week sowing (Table 2). The reduction of yield in October last week sowing might be due to continuous dry spell during second fort night of October, which might have affected the growth of standing crop and the number of capsules/plant. Whereas, in November second week sowing, the reduction was mainly due to moisture stress during December and non-existence of over night dew during capsule filling stage which might have affected the formation of capsules and reduced the seed weight (Table 2). Low yield in first sown crops of sunflower and coriander was reported by Solaiappan (2000) for moisture stress condition and low yield under late sowing situation, is associated with the depletion of soil moisture (Bajpai *et al.* 1990).

During 1997-98, yield from intercrops namely onion and karunganni cotton alone was recorded (Table 1), whereas, during 1999-2000, all intercrops gave yields (Table 2). During 1997-98, intercrop yield of onion and karunganni cotton became highest on November first fortnight and October second fortnight sowing respectively (Table 1). During 1999-2000, highest yields of 80.7 and 754.0 kg ha^{-1} in bengalgram and karunganni cotton respectively, were recorded on October last week sowing, thereafter decreased gradually. Yield of onion reached maximum (2629 kg ha^{-1}) on November first week sowing. The differences in coriander yield equivalent recorded in 1999-2000 due to time of sowing were significant (Table 2). However, during 1997-98, higher coriander yield equivalent of 283 kg ha^{-1} was recorded in the November first fortnight sown crop. Increased yield equivalent for November first fortnight sowing might be due to more yield of onion (Table 1). During 1999-2000, highest yield equivalent of 498 kg ha^{-1} was recorded on October last week sowing and thereafter, the values decreased. However, yield equivalent of November first week sowing (459 kg ha^{-1}) was at par with that of October last week sowing (498 kg ha^{-1}). The mean yield equivalent decreased rapidly and the lowest (267 kg ha^{-1}) was recorded on November second week sowing. The increase

Table 3. Economics of coriander intercropping systems (*Rabi* 1999 – 2000)

Treatment	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	Benefit cost ratio	LER
Time of sowing				
D_1 – October last week	7967	4837	2.31	1.109
D_2 – November first week	7247	4061	2.06	1.103
D_3 – November second week	4298	1378	1.20	1.058
CD (P = 0.05)	1180.4	-	-	0.0706
Intercropping system				
S_1 – Coriander + bengalgram (1:1)	2430	79	0.93	1.007
S_2 – Coriander + bengalgram (2:1)	2712	148	0.01	1.200
S_3 – Coriander + onion (1:1)	11939	9439	3.10	1.011
S_4 – Coriander + onion (2:1)	11348	6768	2.48	1.092
S_5 – Coriander + k.cotton (1:1)	6778	3951	2.38	1.103
S_6 – Coriander + k.cotton (2:1)	6322	3513	2.17	1.217
S_7 – Coriander – sole crop	2004	80	0.92	1.000
CD (P = 0.05)	721.6	-	-	0.0573

in October last week sowing ranged from 8.0 (November first week sowing) to 86.5 per cent (November second week sowing). Higher yield equivalent for early sowing might be due to increased availability of moisture at early growth stage and better overall use of growth resources under intercropping situation and cool temperature prevailed at reproductive stage which might have helped in the formation of pods in bengalgram and boll development in cotton. Willey (1979) reported that main reason for higher yields in intercropping systems is that the component crops are able to use growth resources differently and make better overall use of growth resources than grown separately. October last week sowing, during 1999 - 2000, gave maximum gross income of Rs.7969 ha^{-1} and net income of Rs.4837 ha^{-1} (Table 3). The advantage of early sowing of component crops was evidenced by recording highest benefit cost ratio (2.31) and LER (1.109).

Effect of intercropping

During 1997-98, as there was no economic yield from intercrop of wheat and bengalgram and non-existence of competition for moisture from wheat, the plant height of coriander sown at 2:1 ratio in paired row system was more and the increase ranged from 0.6 cm to 3.4 cm compared to that of coriander sole crop (Table 1). During 1999-2000, the plant height of coriander at maturity reduced due to intercropping and the reduction ranged from 1.5 cm to 3.5 cm compared to that of coriander sole crop (Table 2). The plant height reduction was higher under bengalgram and onion intercropping than with karunganni cotton and particularly reduction was very high when component crops are sown at 2:1 ratio in paired row system as compared to at 1:1 ratio under replacement series.

The coriander yield differences due to intercropping were significant in both 1997- 98 and 1999-2000 (Table 1 and 2). During 1997-98, as there was no economic yield from intercrop wheat and bengalgram, coriander in coriander + wheat and coriander + bengalgram intercropping systems gave similar yields as that of coriander sole crop. The yield loss in coriander due to intercropping with onion was higher (39.5 kg ha^{-1}) as compared to coriander sole crop. This was mainly due to the competition for nutrients and water from onion, which gave highest intercrop yields. The full utilization of intercepted radiation was the cause for improved growth and yield parameters and yield of sole coriander and coriander in coriander + wheat and coriander + bengalgram and coriander + karunganni cotton intercropping system than the coriander in coriander + onion intercropping system. During 1999-2000, the yield loss in coriander due to intercropping was recorded in all intercropping systems. The loss at 1:1 ratio under replacement series was more as compared to that of at 2:1 ratio under paired row system as evivenced by the yield loss of 62.9, 61.6 and 54.3 in 1:1 ratio and 38.8, 29.4 and 27.7 kg ha^{-1} in 2:1 ratio for onion, bengalgram and karunganni cotton intercropping systems respectively. This was in acccordance with that of Palaniappan and Sivaraman (1994) who reported higher yields in sole crops. Higher coriander yields in 2:1 ratio might be due to more yields obtained from per unit area of 100 per cent base crop population. Coriander + onion intercropping system at 1:1 ratio gave

Table 4. Rainfall Particulars

	1997-98	1999-2000
A. Total Rainfall (mm)	403.5	267.6
B. Total No.of rainy days (No)	28	13
C. Quantity of rainfall received by the treatments		
1997-98		
D1 - October second fortnight sowing	401.3 mm in 28 rainy days	
D2 - November first fortnight sowing	278.9 mm in 20 rainy days	
1999-2000		
D1 - October last week sowing		195.6 mm in 11 rainy days
D2 - November first week sowing		222.4mm in 11 rainy days
D3 - November second week sowing		190..8 mm in 9 rainy days

maximum gross income of Rs.11939 ha^{-1}, net income of Rs. 9439 ha^{-1} with highest benefit cost ratio of 3.10 (Table 3).

Interaction effect

The positive effect on growth and yield of coriander and on the yield of onion and karunganni cotton during 1997-98 and on all component crops during 1999-2000 by October last week sowing and November first week sowing tested in this experiment established their suitability to coriander based intercropping systems. Among them, October last week was found suitable for corianer + karunganni cotton intercropping system while November first week sowing was found suitable for coriander sole crop as well as for coriander + onion intercropping system.

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Research Notes

Studies on management practices for summer irrigated cotton genotypes

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Field experiment was carried out during 1995-97 to evaluate the response of pre-release cotton genotypes to spacing and fertilizer levels under summer irrigated conditions. The genotypes (TSH 188 and TSH 192) were tested under three fertilizer levels (40:20:20; 60:30:30 and 80:40:40 kg NPK ha^{-1}) and three spacings (60 x 15 cm; 60 x 30 cm and 60 x 45 cm). The experimental field was medium in available N and P and high in available K with a pH of 8.1. The experiment was carried out in split plot design with two replications. The results of the three years were pooled and presented.

The growth characters (plant height and monopodia), yield attributing characters (sympodia, number of bolls per plant and boll weight), seed cotton yield and quality characters (seed index, lint index and ginning percentage) were not influenced by genotypes studied indicating that both the genotypes performed equally good.

Progressive increase in the number of bolls/ plant was recorded with an increase in the level of fertilizer application and intra row spacing. Similar results of increased number of bolls/ plant with increased nutrient application and increased intra row spacing was observed with Sharma and Tomar (1994) and Brar *et al.* (1996).

Among the three fertilizer levels studied, a moderate dose of 60:30:30 kg NPK/ha^{-1} recorded the highest BC ratio of 2.51 with a mean seed cotton yield of 1395 kg ha^{-1}. Further increase in the fertilizer dose resulted in a moderate increase in the seed cotton yioeld (1454 kg ha^{-1}). However, the BC ratio was reduced indicating an economic optimum of 60:30:30 kg NPK ha^{-1}.

Among the three spacings tried, a closer spacing of 60 x 15 cm was found to be advantageous with the highest mean seed cotton yield of 1488 kg/ha^{-1}. Progressive increase in the intra row spacing resulted in progressive decline in the seed cotton