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Seed Production of Sunnhemp (*Crotalaria juncea* L.) as Influenced by Sowing Time

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ABSTRACT

A field experiment was conducted during *rabi*, 2011-12 on clay loam soils of the Agricultural College Farm, Bapatla to evaluate the influence of sowing time on the seed production of sunnhemp (*Crotalaria juncea L.*) in costal eco system. The crop was sown on 1st October, 15th October, 1st November, 15th November, 1st December, 15th December, 1st January, 15th January, 1st February and 15th February respectively. Among the different sowing dates, the crop sown on 1st October recorded significantly higher seed yield (1066 kg ha^{-1}), stalk yield (4485 kg ha^{-1}) gross returns (Rs. 57698 ha^{-1}), net returns (40989 ha^{-1}), returns per rupee invested (Rs 3.45). The crop sown on 1st October received highest heat use efficiency (0.52 and 0.54) than other sowings and lowest was recorded with February sowings (0.19 and 0).

Key words : Growing Degree Days, Heat Use Efficiency, Seed yield, Sowing time, S*unnhemp*.

Greenmanure crops are mostly raised for the production of biomass which normally are incorporated at pre flowering stage. Sunnhemp is an important greenmanure crop cultivated all over India. The availability of adequate quantities of good quality seed is the major constraint to grow sunnhemp as a green manure crop. Lot of work on its utility as greenmanure crop has been done, but no serious efforts were made to develop proper agronomic practices for seed production of sunnhemp crop.

Time of sowing is an important agronomic practice and non-monetary input. The maximum seed yield can be achieved by sowing the crop at optimum time, which is mainly depending on the agro climatic conditions of the region. The present investigation was conducted at Agricultural College Farm Bapatla to find out the optimum sowing time for seed production of sunnhemp.

MATERIAL AND METHODS

The field experiment was conducted at Agricultural College Farm, Bapatla in *rabi* 2011-12. The soil of experimental plot was clay loam, having pH of 7.2 and its nutrient statusis 76, 22 and 170 kg ha^{-1} of available N, P and K respectively. The soil was low in nitrogen, medium in phosphorous and low in potassium. This experiment was laid out in Randomized Block Design with three replications. The experiment comprises ten dates of sowing *viz.* T_1-October1st; T_2-October 15th; T_3-November 1st; T_4-November 15th; T_5-December 1st; T_6-December 15th; T_7-January 1st; T_8-January 15th; T_9- February 1st; T_{10}-February 15th. N, P and K were applied @ 25, 50 and 30 kg ha^{-1} respectively through urea, SSP and MOP uniformly as basal to all the plots. The recommended package of practices were adopted to raise the crop. The weekly mean maximum, mean minimum temperatures and mean relative humidity were recorded. Maximum temperature ranged from 28.2 ^{0}C to 45.5 ^{0}C, minimum temperature ranged from 14.1 ^{0}C to 30.4 ^{0}C, and mean relative humidity ranged from 45.3 to 86.9 %, respectively. A total rainfall of 275.1 mm was received in 12 rainy days during the crop growth period. The day length ranged from 11.11 to 13.04 hours day^{-1} with a mean value of 12.07 hours day^{-1}, while the bright sunshine hours recorded during the course of investigation ranged between 4.8 to 9.1 hours day^{-1} with a mean value of 7.26 hours day^{-1}. The base temperature taken for the cropswas 10 ^{0}C (Thomas and Palaniappan, 2007).

The GDD were calculated by using the following equation (Iwata, 1984).

$$GDD\ (^0C\ day) = \frac{[T_{max} - T_{min}]}{2} - T_b$$

Where T_{max} = Maximum temperature
T_{min} = Minimum temperature
T_b = Base temperature

$$HUE\ (kg\ ha^{-1}\ ^0C\ day^{-1}) = \frac{\text{Total dry matter / Seed yield (kg ha}^{-1})}{\text{Accumulated heat units (}^0C\text{ day)}}$$

RESULTS AND DISCUSSION

Yield and yield attributes of sunnhemp was significantly influenced by sowing time. Maximum plant height, number of branches plant^{-1}, number of pods plant^{-1}, test weight, seed and stalk yield and harvest index were recorded with 1st October sowing which was on a par with 15th October sowing. Delay in sowings effected the yield and yield attributes of sunnhemp and yields were significantly reduced (Table 1). The 1st October sown crop significantly produced highest seed yield of 1068 kg ha^{-1} and it was on a par with 15th October sowing and it might be due to maximum number of branches, number of pods and test weight. More congenial weather conditions like adequate amount of rainfall during the crop growth period and partitioning the higher proportion of its total dry matter into the reproductive parts of the plant. Added to the above, better growth of early sown crop, when compared to later sowing dates in all aspects might have reflected in better yield expression. These results are in conformity with those of sangeetha et al (2011). The crop sown on 15th February failed to flower which might be due to unfavourable weather conditions such as high temperatures and long day conditions, which might have forced to prolong the vegetative growth and these findings are in conformity with those of Cook and White (1995) i.e., sunnhemp is a typically photoperiod sensitive crop in which longer day length favoured vegetative growth period only but not flowering, which corroborates with findings of present investigation. Similar findings were also observed by Thomas and Palaniappan (1997) in sunnhemp.

The crop sown on October 1st produced significantly more number of branches/ plant, Number of pods/ branch and test weight when compared to other dates of sowing. The highest yield attributes obtained in early sowings a due to the fact that the crop experienced longer period of vegetative stage coupled with favourable weather conditions that might have resulted in increased leaf area, adequate availability of photosynthates and enhanced translocation of food reserves leading to better seed filling and bold grains. The results obtained are in accordance with the findings of Kumar *et al.* (2005) in sunnhemp, Sangeetha *et al*. (2011) in dhaincha.

Growing degree days

The accumulated growing degree days (^0C day) and heat use efficiency during crop growth period were recorded. The accumulated growing degree days (GDD) ranged from 1666 to 2097 ^0C day and it was maximum (2097 ^0C day) with the crop sown on 15th February. The lower GDD experienced in December 1st sowing (1666 ^0C day) and it might be due to late planting coupled with low temperatures and short day conditions.

Heat Use Efficiency (HUE)

The heat use efficiency recorded for seed yield and dry matter accumulation at harvest was presented in (Table 2). Time of sowing significantly influenced the heat use efficiency, maximum seed yield and drymatter accumulation recorded with crop sown on 1st and 15th October (0.52, 0.54 kg ha^{-1} ^0C day^{-1}) for seed yield and (2.62, 2.73 kg ha^{-1} ^0C day^{-1}) for dry matter accumulation, which is due to influence of HUE on crop growth and there by better utilization of temperature. Lowest HUE was noticed in the crop sown on 15th February & 15th November. The highest HUE in seed yield and drymatter accumulation might be due to optimum temperature and higher rate of photosynthesis during the crop growth stages.

Relationship between drymatter accumulation, seed yield and heat use efficiency.

The relationship between dry matter accumulation, seed yield and HUE was worked out and found that there is a linear relationship between

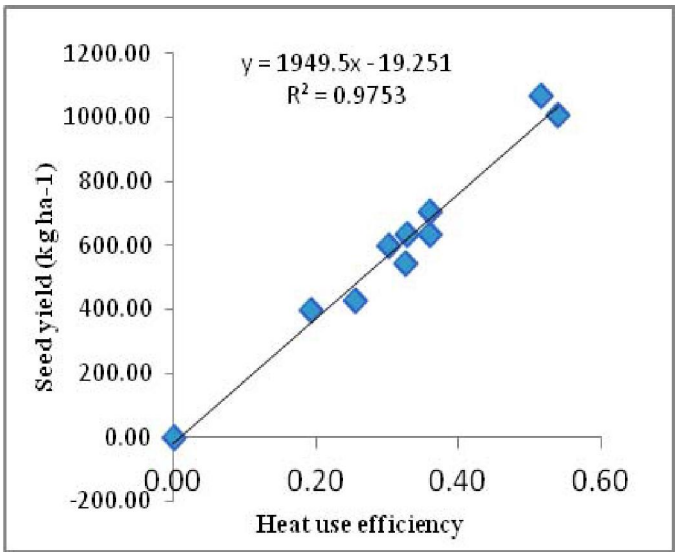

Fig 1. Regression relationship between seed yield and heat use efficiency.

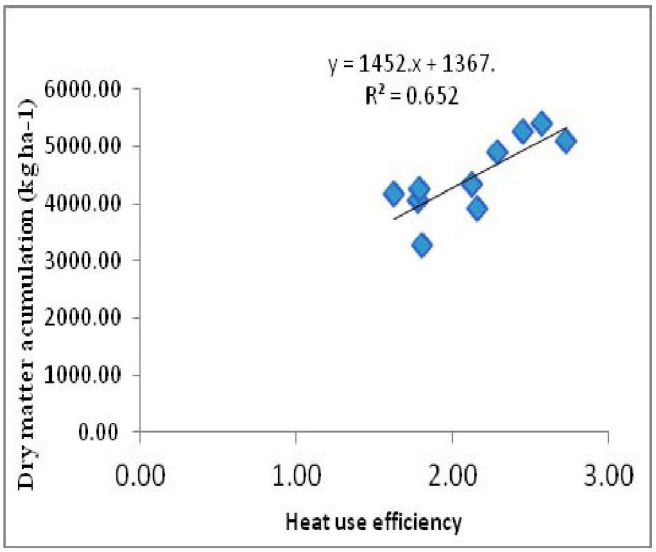

Fig 2. Regression relationship between drymatter and heat use efficiency.

Table 1. Yield and yield attributes of sunnhemp as influenced by sowing time.

Time of sowing	Plant height (cm)	Number of branches plant^{-1}	Number of pods plant^{-1}	Test weight in (g)	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	H. I (%)	Total Gross returns (₹)$^{-1}$	Cost of cultivation (₹)$^{-1}$	Total Net returns (₹)$^{-1}$	Returns per rupee invested (₹)
October 1st	170.9	8	61	28.2	1,068	4,485	19.9	57885	16709	41176	3.46
October 15th	160.9	7	55	27.2	1,006	4,236	19.2	54556	16709	37847	3.27
November 1st	144.7	6	42	25.7	636	3,558	15.2	35338	16856	18482	2.10
November 15th	130.3	6	35	25.2	542	3,328	14.1	24728	16856	7872	1.47
December 1st	117.8	5	31	23.8	428	2,893	12.9	29993	16856	13137	1.78
December 15th	158.8	6	47	22.5	636	3,656	14.8	35456	16856	18600	2.10
January 1st	166.2	8	57	22.0	704	4,299	13.6	39498	16800	22698	2.35
January 15th	152.1	7	44	22.0	600	4,186	12.6	34186	16800	17386	2.03
February 1st	135.9	6	24	21.5	396	3,889	9.3	23689	16800	6889	1.41
February 15th	119.7	5	-	-	-	3,865	0.00	3865	16800	-12935	0.23
SE m (±)	4.26	0.31	3.04	0.68	31.5	113.2	0.54	-	-	-	-
CD (P= 0.05)	12.6	0.9	9.1	2.0	95	336	1.6	-	-	-	-
CV%	5.0	8.6	12.0	4.8	8.2	5.1	6.4	-	-	-	-

these parameters. Equation fitted was significant based on R^2 value at 5% level of significance. The linear relationship between Total drymatter accumulation and HUE was 65.2% seed yield and HUE was 97.5% (Fig.1& Fig.2).

Economics:

The maximum gross returns, net returns and returns per rupee invested were recorded with the crop sown on 1st October and minimum with February 15th sowing (Table.1),These results are conformed with those of Kumar *et al*. (2005) in sunnhemp, Kumar *et al*. (2006) and Triveni *et al*. (2012) in dhaincha.

Conclusion:

The sunnhemp crop sown during the month of October is congenial for realizing higher seed

Table 2. Heat use efficiency of sunnhemp crop at harvesting stage as influenced by sowing time.

Dates of sowing	GDD (^{0}C day^{-1})	Seed yield (kg ha^{-1})	Drymatter accumu lation at maturity (kg ha^{-1})	HUE of seed yield (kg ha^{-1} ^{0}C day^{-1})	HUE of total dry matte (kg ha^{-1} ^{0}C day^{-1})
October 1st	2,066	1068	5410	0.52	2.62
October 15th	1,862	1006	5087	0.54	2.73
November 1st	1,759	636	4045	0.36	2.30
November 15th	1,678	428	3928	0.26	1.95
December 1st	1,666	542	3273	0.33	2.36
December 15th	1,774	636	4353	0.36	2.24
January 1st	1,953	704	5260	0.36	2.69
January 15th	1,982	600	4905	0.30	2.48
February 1st	2,037	396	4050	0.19	2.08
February 15th	2,097	0	3783	0.00	1.98

yield and stalk yield. Similarly, maximum gross returns, net returns and return per rupee invested were also recorded with early sowings of sunnhemp crop. Temperature and photoperiod markedly influenced on drymatter production, yield attributes and seed yield of sunnhemp. The highest HUE was observed in October sowings and lowest with February sowings.

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