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Influence of Dates of Sowing and Fertilizer on Growth and Seed Yield of Sunnhemp Genotypes

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***Abstract* — A field experiment was conducted during *kharif* 2016, to study the effect of date of sowing and fertilizer application on seed yield and quality of Sunnhemp genotypes (*Crotalaria juncea* L.) at Agricultural Research Station, Kalloli, Gokak taluk Belagavi district, University of Agricultural Sciences, Dharwad. The field experiment comprised of twenty four treatments with three replications in double split plot design. Among different dates of sowing, D_3-First fortnight of August registered less days to flower initiation and 50 per cent flowering (36.22 and 55.50 days respectively) followed by second fortnight of July (D_2-38.20 and 60.62 days respectively) and more number of days were shown in first fortnight of July (D_1-40.12 and 65.62 days respectively). With respect to fertilizer levels, F_1-25:50:25 NPK kg ha^{-1} recorded less number of days for flower initiation and 50 per cent flowering (36.58 and 57.07 days respectively) followed by F_2 (38.01 and 59.91 days respectively) and F_3 (39.95 and 64.76 days respectively). D_3-first fortnight of August was recorded significantly higher seed yield per plot (1.04 kg) than D_2-second fortnight of July (0.97 kg) and D_1-first fortnight of July (0.90 kg). Fertilizer levels had a significant influence on seed yield per plot. Higher fertilizer level, F_3 - 37.5 : 75 : 37.5 NPK kg ha^{-1} recorded significantly higher seed yield per plot (1.04 kg) than F_2 - 31.25 : 62.5 : 31.25 (0.99 kg) and F_1 – 25 : 50 : 25 NPK kg ha^{-1} (0.87 kg). Higher seed yield per hectare was recorded in D_3-first fortnight of August (1,798 kg) as compared to the D_2 and D_1 (1,686 and 1,569 kg respectively). Among the fertilizer level, F_3 - 37.5 : 75 : 37.5 NPK kg ha^{-1} recorded significantly higher seed yield per hectare (1,808 kg) than F_2 - 31.25 : 62.5 : 31.25 NPK kg ha^{-1} and F_1 – 25 : 50 : 25 NPK kg ha^{-1} (1,727 and 1,517 kg respectively).**

***Keywords* — Dates of Sowing, Fertilizer Levels, Genotypes, Flower Initiation, Fifty Per Cent Flowering, Seed Yield.**

I. INTRODUCTION

Sunnhemp (*Crotalaria juncea* L) belongs to the family of Fabaceae. It is an annual shrub cultivated for multipurpose legume especially for its fine fibre in many countries including India. The crop is grown as a legume or fodder. In India it is grown over an area of 63,000 hectare with a production of 35,000 metric tonnes. It is grown in almost all states of India either as a fibre crop, green manure or fodder crop. The states like Bihar, Madhya Pradesh, Maharashtra, Rajasthan, Orissa and Uttar Pradesh grow this crop mainly for fibre. These states cover nearly 87 per cent of the total area under cultivation of sunnhemp crop (Hazra *et. al*., 2011).

Sunnhemp is a short-day, erect shrubby annual, generally 1 to 4 m in height. The stems are cylindrical and ribbed. Branching in the upper portion is minimized with dense planting. It is an important source of natural fibre crops in India. It belongs to genus *Crotolaria,* which consists over 600 species of which *Crotolaria juncea* L., is the most popular green manure crop (Whyte and Trumple, 1953). Apart from its green manuring value is gaining importance because of increasing demand for a specific grade fibre needed for manufacture of tissue paper and paper for currency as it contains high percentage of cellulose and low amount of lignin. However, the non-availability of good quality seed is one of the constraints in popularizing sunnhemp cultivation.

Sunnhemp is the fastest growing species of the genus and is very effective in smothering out weeds. Almost any well drained soil is suitable for *kharif* crop. It grown during rainy season is mainly utilized as a green manure crop (Dempsey, 1975). For fibre, it is grown on fairly light well drained soil (alluvium soil-old or new) having sandy loam or loamy textured soil that retains sufficient moisture. Soil moisture per cent of 30 helps in good and effective germination.

Interest towards green manure crops has been renewed with the growing emphasis on sustaining soil fertilities and farming system. Green manuring is one of the most effective and environmentally sound methods of manuring crops that offers an opportunity to improve soil physico-chemical environment and to cut down the use of chemical fertilizers which are often blamed for causing environmental pollution and escalating the cost of cultivation of crops (Purseglove, 1968). The effectiveness of a green manure crop is related to its seed production and ability to accumulate higher amounts of nutrients within a short period of time. Seed production, however, is mostly affected by seeding density and the soil fertility status especially phosphorus availability. Enhancement in phosphorus supply to green manure crops, which are mostly of leguminous may increase their ability to fix up more atmospheric nitrogen and result in high producing of quality seed. Further, the availability of adequate amount of quality seed of green manure crops is a constraint to go for the practice of green manuring. Structured research work on seed production on green manure crops is meagre and scanty.

II. MATERIAL AND METHODS

The field experiment on sunnhemp was carried out at Agricultural Research Station Kalloli, and seed quality studies were conducted at Seed Quality and Research Laboratory, National Seed Project (Crops), University of Agricultural Sciences, Dharwad. Kalloli, is situated in Northern Dry Zone of Karnataka and located at 74^0

48'96'' North latitude, 16^0 13'70'' East longitudes with an altitude of 553 M above mean sea level. The field experiment was laid out in a double split plot design with three factors, Main plot: Dates of sowing (D), i.e. D_1- 1st fortnight of July, D_2 - 2nd fortnight of July, D_3- 1st fortnight of August. Sub-plot: Genotypes (G), i.e. G_1- Local and G_2 - SUN-053 and Sub sub plots: Fertilizer levels (F), i.e. F_1- 25:50:25 NPK kg ha^{-1}, F_2- 31.25:62.5:31.25 NPK kg $ha^{-1}$and F_3- 37.5:75:37.5 NPK kg ha^{-1}.

The observations on days to flower initiation and days to 50 per cent flowering, seed yield per plot (kg) and seed yield per hectare were recorded at respective stages.

III. Results and Discussion

Days to flower initiation and 50 per cent flowering, were more in the early sown crop. The delayed sowing resulted in early flowering (Table 1). The D_1-July first fortnight sown crop took more number of days to flower initiation and 50 per cent flowering (40.12 and 65.62 days respectively) compared to the crop sown on August first fortnight (36.22 and 55.50 days respectively). The delay in flowering with the early sown crop due to planting experienced long day conditions which affected the reproductive phase and the development of flower buds into full bloom stage. Hence, crop planted during July was exposed to long day conditions induced the delayed flowering. These results are in confirmation with the findings of Reddy *et al*. (2014) and Kaushal *et al*. (2014). With respect to fertilizer level, F_1 recorded less number of days for flower initiation and 50 per cent flowering (36.58 and 57.07 days respectively) and more number of days took by F_3 (39.95 and 64.76 days respectively). Similar finding was also reported by Kaushal *et al*. (2014) who observed in Kamini genotype, taking more days for flowering (119.20 days) than Shashank and Violet Cushion in China Aster.

Sunnhemp sown on D_3-first fortnight of August recorded significantly higher seed yield (1,798 kg ha^{-1}) when compared to crop sown on D_1-first fortnight July (1,569 kg ha^{-1}) and D_2-second fortnight of July (1,686 kg ha^{-1}). The higher seed yield in D_3-first fortnight of August can also be related to higher values of yield components over the early sown crop. These results are in conformity with the findings of Das *et al*. (2014), who had also observed that jute crop sown on 9th August significantly recorded higher seed yield and dry matter production compared to crop that sown on 25th July and 24th August.

In the present investigation, higher seed yield (1.04 kg $plot^{-1}$ and 1808 kg ha^{-1}) was obtained with higher fertilizer level, F_3-37.5:75:37.5 NPK kg ha^{-1}than medium level of fertilizer level F_2-31.25:62.5:31.25 NPK kg ha^{-1} (0.99 kg $plot^{-1}$ and 1727 kg ha^{-1}) and low F_1-25:50:25 NPK kg ha^{-1} (0.87 kg $plot^{-1}$ and 1517 kg ha^{-1}) fertilizer levels. Increase in the seed yield was due to increased availability of nutrients (nitrogen, phosphorus and potassium) causing accelerated photosynthetic rate and thus lead to the more production of photosynthesis. The maximum yield with high rate of fertilization could also be attributed to better performance of crop which was obviously for higher growth components like plant height, number of branches and dry matter production that resulted in over medium F_2-31.25:62.5:31.25 NPK kg ha^{-1} and low F_1-25:50:25 NPK kg ha^{-1} (1517 kg ha^{-1}) fertilizer levels. These results are in conformity with the finding of Santosh *et al*. (2010), Gupta (2006).

IV. Summary and Conclusion

The experimental results indicated that, less number of days to flower initiation and days to 50 per cent flowering in $D_3G_2F_1$ (34.57 and 50.54 respectively) treatment combination and depicted in Table-1. With respect to seed yield, $D_3G_1F_3$ recorded highest seed yield per plot (1.15 kg), seed yield per hectare (1,999 kg) and depicted in Table 2.

Table 1. Days to flower initiation and days to 50 per cent flowering as influenced by date of sowing, genotypes and fertilizer levels

Treatments		Days to flower initiation (days)					Days to 50% of flowering (days)				
		Fertilizer levels					Fertilizer levels				
Date of sowing	Genotype	F_1	F_2	F_3	Mean	Mean	F_1	F_2	F_3	Mean	Mean
D_1	G_1	39.52	40.44	41.05	40.33	40.12	63.17	65.98	68.80	65.98	65.62
	G_2	38.03	40.17	41.51	39.90		62.22	65.27	68.30	65.26	
	Mean	37.30	38.27	40.21			57.72	60.54	65.76		
D_2	G_1	37.44	39.22	40.60	39.09	38.20	57.32	60.57	67.47	61.79	60.62
	G_2	34.97	37.46	39.46	37.30		56.51	57.81	64.03	59.45	
	Mean	36.21	38.34	40.03			56.91	59.19	65.75		
D_3	G_1	34.93	35.16	38.99	36.36	36.22	52.66	55.07	61.00	56.24	55.50
	G_2	34.57	35.59	38.07	36.08		50.54	54.75	58.97	54.75	
	Mean	34.75	35.38	38.53			51.60	54.91	59.99		
Mean of G_1		37.30	38.27	40.21	38.59		57.72	60.54	65.76	61.34	
Mean of G_2		35.86	37.74	39.68	37.76		56.42	59.28	63.77	59.82	
Mean		36.58	38.01	39.95			57.07	59.91	64.76		

Sources	S.Em. ±	C.D. (P = 0.05)	S.Em. ±	C.D. (P = 0.05)
Date of sowing (D)	0.23	0.91	0.48	1.89
Genotypes (G)	0.20	1.21	0.38	1.30
fertilizer (F)	0.26	0.77	0.85	2.47
D × G	0.35	NS	0.66	NS
D × F	0.45	NS	1.46	NS
G× F	0.37	NS	1.19	NS
D × G × F	0.64	NS	2.07	NS

D_1- 1st fortnight of July D_2- 2nd fortnight of July D_3- 1st fortnight of August G_1- Local
F_1- 25:50:25 NPK kg/ha F_2- 31.25:62.5:31:25 NPK kg/ha F_3- 37.5:75:37.5 NPK kg/ha G_2- SUN-053

Table 2. Seed yield per plot and seed yield per hectare as influenced by date of sowing, genotypes and fertilizer levels.

Treatments		Seed yield (kg plot^{-1})					Seed yield (kg ha^{-1})				
		Fertilizer levels					Fertilizer levels				
Date of sowing (D)	Genotype	F_1	F_2	F_3	Mean	Mean	F_1	F_2	F_3	Mean	Mean
D_1	G_1	0.84	0.91	1.00	0.92	0.90	1,465	1,580	1,730	1,592	1,569
	G_2	0.82	0.88	0.97	0.89		1,425	1,535	1,680	1,547	
	Mean	0.88	1.01	1.07			1,534	1,752	1,850		
D_2	G_1	0.87	1.03	1.05	0.98	0.97	1,506	1,790	1,820	1,705	1,686
	G_2	0.85	1.01	1.02	0.96		1,476	1,749	1,775	1,667	
	Mean	0.86	1.02	1.04			1,491	1,769	1,797		
D_3	G_1	0.94	1.09	1.15	1.06	1.04	1,630	1,885	1,999	1,838	1,798
	G_2	0.92	1.05	1.06	1.01		1,605	1,825	1,846	1,758	
	Mean	0.93	1.07	1.11			1,617	1,855	1,922		
Mean of G_1		0.88	1.01	1.07	0.99		1,534	1,752	1,850	1,712	
Mean of G_2		0.87	0.98	1.02	0.95		1,502	1,703	1,767	1,657	
Mean		0.87	0.99	1.04			1,517	1,727	1,808		

Sources	S.Em. ±	C.D. (P = 0.05)	S .Em. ±	C.D. (P = 0.05)
Date of sowing (D)	0.010	0.041	17.91	70.31
Genotypes (G)	0.006	0.038	10.86	66.05
fertilizer (F)	0.009	0.026	15.61	45.57
D × G	0.011	NS	18.80	NS
D × F	0.016	NS	27.04	NS
G× F	0.013	NS	22.08	NS
D × G × F	0.022	NS	38.25	NS

D_1- 1st fortnight of July D_2- 2nd fortnight of July D_3- 1st fortnight of August G_1- Local
F_1- 25:50:25 NPK kg/ha F_2- 31.25:62.5:31:25 NPK kg/ha F_3- 37.5:75:37.5 NPK kg/ha G_2- SUN-053

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