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Growth and yield of sunhemp varieties influenced by various sowing windows under rice fallow system

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ABSTRACT

A field experiment was conducted to study "Performance of sunhemp varieties under different sowing windows for seed production in rice fallow system in NC zone"during *Rabi* 2023-24 at Agricultural College Farm, Naira. The experiment was laid out in a Factorial randomised block design with two factors and three replications. Factor one comprised of three varieties, JRJ 610 (V_1), SUIN 03 (V_2) and SUIN 037 (V_3) and factor two comprised of four sowing windows *i.e.* first fortnight of November (S_1), second fortnight of November (S_2), first fortnight of December (S_3) and second fortnight of December (S_4). The results revealed that sunhemp variety, SUIN 037 was recorded maximum dry matter production (4847 kg ha^{-1}), number of pods plant^{-1} (50.42), number of seeds pod^{-1} (9.58) and seed yield (1129 kg ha^{-1}). First fortnight of November, sowing window recorded significantly highest dry matter production (5200 kg ha^{-1}), number of pods plant^{-1} (53.83), number of seeds pod^{-1} (9.74), test weight (46.33g) and seed yield (1129 kg ha^{-1}) . Sunhemp variety, SUIN037, sown during first fortnight of November recorded significantly high dry matter production (5235 kg ha^{-1}), number of pods plant^{-1} (60.15) and seed yield (1305 kg ha^{-1}) indicating its adoptabuility for this location and coming window for higher yields.

Key words: *Sunhemp, Sowing window, Varieties and Yield*

Sunhemp (*Crotalaria juncea* L.) is a member of sub-order Papilionaceous of the order fabales and belongs to Fabaceae family. It is the sole cultivated species in the genus *Crotalaria* which consists of over 600 species and is the most popular green manure crop. Its cultivation in India spans throughout the country with major areas in the states of Madhya Pradesh, Chhattisgarh, Odisha, Uttar Pradesh, Maharashtra and Tamil Nadu etc. Area under sunhemp in Andhra Pradesh for seed and fibre is 7132 ha (Season and Crop Report– Andhra Pradesh 2022-23). In North Coastal Zone of Andhra Pradesh, the area and production of sunhemp seed crop is 2110 ha with the production of 2108 tonnes (apagrisnet.govt.in). Sunhemp crop performed better in ricefallow situation in relation to growth and seed yield and it is ideal to take up for seed production purpose during *rabi* in rice fallow situation and the same seed may be utilized for green manuring in pre *kharif* season to enrich the soil fertility at farmer's level. Environmentally, sunhemp plays a vital role in preventing soil erosion due to its dense foliage and root system, which protect the soil, especially on slopes and in erosion-prone areas. Additionally, the production of sunhemp seeds supports biodiversity, maintaining a variety of plant species within agricultural systems, promoting ecosystem stability, and resilience. As seed is the major limitation in sunhemp and other bast fibre crops like jute because of different photo-period requirements for seed crop and fibre crop (Bhandari *et al.,* 2022). Optimum sowing time and suitability of newly released varieties are the major key for climate resilient and useful to sustain the yield of all crops. Right time of sowing is major agro-technique which is helpful for significant interaction with climatic factors of CO_2, rainfall, temperature with the use of crop simulation models it also affects the crop-pest interaction and crop weed competition (Agrawal, 2008). Availability of newly released quality seed to the farmers at proper time is one of the major constraints faced by sunhemp farmers. For this purpose, research is essential to know the optimum sowing date of sunhemp and to develop new varities suitable to thissituvation. Keeping these points in view,

the present investigation was undertaken with the objective to study the growth and yield of sunhemp varieties influenced by various sowing windows under rice fallow system of North Coastal Zone of Andhra Pradesh.

MATERIAL AND METHODS

The present field experiment was conducted during *rabi,* 2023-24 at Acharya N.G. Ranga Agricultural University,Agricultural College Farm, Naira, , Andhra Pradesh, which is geographically situated at 18.24^0 N latitude, 83.84^0 E longitudes and with an altitude of 27 m above mean sea level in the North Coastal Zone of Andhra Pradesh. The weekly mean maximum and minimum temperature ranged from 27.8 ^{o}C to 40.5 ^{o}C and 16.8 ^{o}C to 25.6 ^{o}C respectively, while the average maximum and minimum temperature during the crop growth period were 33.20^{o}C and 21.54^{o}C. During the corresponding period mean relative humidity of forenoon and after noon ranged from 65.48 to 84.91 per cent with an average of 77.29 per cent. A total rain fall of 92.20 mm was received in 4 rainy days during the crop growth period and the remaining amount of water was applied as the crop needs in regular intervals. Favourable conditions of weather prevailed for the successful growth of experimental crops *i.e.,* sunhemp in rice-fallow system. The experiment was laid out in a Factorial randomised block design with three replications. Factor one comprised of three varieties JRJ 610(V_1), SUIN 03(V_2) and SUIN 037(V_3) and factor two comprised of four sowing windows 1st fortnight of November (S_1), 2nd fortnight of November (S_2), 1st fortnight of December (S_3) and 2nd fortnight of December (S_4) and sowings are done in respective sowing dates. Observations were recorded on five randomly selected plants from each replication. The readings from these five plants were averaged replication-wise and the mean data were used for statistical analysis. Data were collected on various characters such as the plant height, number of primary branches per plant, dry matter accumulation (kg ha^{-1}), leaf area index, number of pods per plant, number of seeds per pods, seed yield (kg ha^{-1}) and test weight (g). The number of branches per plant at 60 DAS and dry matter production were recorded at harvest after sowing during the growth season, while yield characteristics were measured at harvest stage of crop.

RESULTS AND DISCUSSION

Effect of varieties and sowing windows on growth parameters of sunhemp

The data pertaining to the number of primary branches plant^{-1}, plant height, LAI and dry matter production (kg ha^{-1}) were influenced by varieties and sowing windows have been presented in table 1. Among all growth parameters, dry matter production (kg ha^{-1}) only significantly influenced by sunhemp varieties at harvest, The highest dry matter production was recorded in sunhemp variety SUIN 037 (4847 kg ha^{-1}) followed by JRJ 610 (4518 kgha^{-1}) and the least was recorded in variety SUIN 03 (4076 kg ha^{-1}). In case of various sowing windows of sunhemp, all growth parameters were significantly influenced at 60 DAS. recoverded the significately high nevlar . First fortnight of November (S_1) *i.e.,* 6.31, followed by second fortnight of November (S_2) *i.e.,* 5.76. The least number of primary branches was observed at second fortnight of December (S_4) *i.e.,* 5.36. Sunhemp sown earlier in the season may have longer vegetative phase, allowing more time for branches development. Similar observations were also reported by Kaur *et al*. (2024). Maximum plant height was observed in second fortnight of December (S_4) *i.e.,* 126.5 followed by first fortnight of December (S_3) *i.e.,* 120.2cm, second fortnight of November (S_2) *i.e.,* 114.8 and significantly lowest plant height was recorded at first fortnight of November (S_1) *i.e.,* 113.3. This might be due to temperature difference that enhanced the accumulation of more photosynthates than other sowing windows and also genetic potential helped in producing more leaves that result in more accumulation of photosynthates and also favoured the plant height (Kundu *et al*., 2013).

The current findings are in close compliance with those of Rafaat *et al*. (2021), Kushwaha *et al*. (2006) and Gohil *et al*. (2016). Significantly maximum LAI was recorded at first fortnight of November (S_1) *i.e*., 3.32 followed by second fortnight of November (S_2) *i.e*., 3.10 and the least LAI was observed at second fortnight of December (S_4) *i.e*., 2.91. Early sowing of crop leads to increase in accumulation of more photosynthates due to presence of high temperatures and resulted in more vegetative growth and increased in leaf area per plant (Kaur *et al*., 2024). These results are similar with the findings of Das *et al*. (2022) and Subbulakshmi (2021). At

Table-1: Influence of varieties and sowing windows on growth parameters of sunhemp

Treatments	Primary branches plant^{-1}	Plant height (cm)	LAI	Dry matter production (kg ha^{-1}) at harvest
Varieties				
V_1- JRJ 610	5.79	117.3	3.12	4518
V_2- SUIN 03	5.57	115.4	2.98	4076
V_3- SUIN 037	5.91	123.5	3.16	4847
SEm±	0.14	2.87	0.05	91.5
CD (p=0.05)	NS	NS	NS	101.5
CV (%)	8.77	8.49	6.62	8.52
Sowing windows				
S_1-First fortnight of November	6.31	113.3	3.32	5200
S_2-Second fortnight of November	5.76	114.8	3.1	4864
S_3- First fortnight of December	5.6	120.2	3	4218
S_4- Second fortnight of December	5.36	126.5	2.91	3531
SEm±	0.16	3.32	0.06	268.5
CD (p=0.05)	0.49	9.75	0.2	298.5
CV (%)	8.77	8.49	6.62	8.52
Interaction (V x S)	NS	NS	NS	S

Table.2: Interaction effect of varieties and sowing windows on dry matter production (kg ha^{-1}) of sunhemp

Treatments	S_1	S_2	S_3	S_4	Mean
	First fortnight of November	Second fortnight of November	First fortnight of December	Second fortnight of December	
V_1- JRJ 610	5235	5068	4095	3676	**4518**
V_2- SUIN 03	4745	4210	3698	3354	**4076**
V_3- SUIN 037	5620	5315	4861	3564	**4847**
Mean	**5200**	**4864**	**4218**	**3531**	
	SEm(±)	**CD(p=0.05)**	**CV (%)**		
Varieties (V)	91.5	268	8.5		
Sowing windows (S)	101.5	298.5	8.5		
V x S	183.1	537.2			
S x V	180.7	534.5			

harvesting stage, the highest dry matter accumulation was recorded at first fortnight of November (S_1) *i.e.*, 5200 kg ha^{-1} followed by second fort night of November (S_2) *i.e.*, 4864 kg ha^{-1} and first fortnight of December (S_3) *i.e.*,4218 kg ha^{-1} and the least dry matter production was recorded at second fortnight of December (S_4) *i.e.*,3531 kg ha^{-1}. Maximum dry matter recorded at first fortnight of November is due to greater growing degree days of the crop in early sown crop. Longer day length leads to more vegetative growth and takes longer time to maturity. These results are consistent with Reddemma *et al*. (2024), Sanjana *et al*. (2021) and Bhardwaj *et al*. (2005). In interaction effect (Table 2.), Sunhemp variety, SUIN037 (V_3) sown during first fort night of November (S_1) recoverded significantly the highest dry matter production (5235 kg ha^{-1}). However, under late sown conditions variety, JRJ 610, recorded the maximum dry matter production at second fortnight of December (S_4) *i.e.,* 3676 kg ha^{-1} compared to the other varieties.

Effect of varieties and sowing windows on yield attributes and yield of sunhemp

Yield attributes are the most important and desirable traits of the crop that are directly related to the yield. The data presented in table 3 indicated the number of pods plant^{-1}, no. of seeds pod^{-1}, test weight (g) and seed yield (kg ha^{-1}) of sunhemp as influenced by different varieties and sowing windows. All yield attributes and yield of sunhemp were significantly affected by varieties and sowing windows. However, in case of interaction effect of varieties and sowing windows, number of pods plant^{-1} and seed yield (kg ha^{-1}) were significantly influenced . Sunhemp variety, SUIN 037 (V_3), recorded the maximum no. of pods (50.42), no. of seeds pod^{-1} (9.58) and the highest seed yield (1129 kg ha^{-1}). However, sunhemp variety JRJ 610 (V_1), recorded significantly the highest test weight (43.25). This is due to genetic variability that enhances source to sink reaction which helps in better development of pods and seeds that helps in increasing yield. These results were confirmatory to the results of Anil *et al*. (2022). Among the four sowing windows, the highest number of pods plant^{-1} (53.83), number of seeds pod^{-1} (9.74), test weight (46.33g) and seed yield (1129 kg ha^{-1}) are recorded in first fortnight of November (S_1).The lowest seed yield (814 kg ha^{-1}) was registered at second fortnight of December (S_4). The late vegetative and blooming stages of the crop's optimal cumulative mean temperature may have positively influenced the time of flower opening, leading to the observed increase in the number of seeds per pod. As a result, the sunhemp crop planted during the first fortnight of November had a higher yield (S_1). The data unequivocally demonstrate that effective fertilisation is favoured by a high mean day temperature and a cool night time temperature. Similar outcomes were verified by Ray *et al*. (2020) and Reddemma *et al*. (2024).

Data presented in table 4 represents the interaction effect between varieties and sowing windows and was significantly influenced on number of pods plant^{-1} and seed yield. The sunhemp variety, SUIN 037 (V_3) sown at first fort night of November (S_1) recorded significantly highest number of pods per plant (60.15) and seed yield (1305 kg ha^{-1}) which was followed by V_3S_2. The lowest number of pods per plant (37.62) and grain yield (814.5 kg ha^{-1}) are recorded in SUIN 03 (V_2) sown during second fortnight of December (S_4). The reduction in seed yield under delayed sowing could also be due to less translocation of photosynthatics towards reproductive parts, rapid initiation of inflorescence, flowering, fruiting and maturity, a less number of pods and less pod filling duration because of non-fulfilment to temperature demands under late sowing. High temperatures and long days accelerated rapid maturity

Table 3: Yield attributes and seed yield of sunhemp influenced by varieties and sowing windows

Treatments	No. of pods plant^{-1}	No. of seeds pod^{-1}	Test weight (g)	Seed Yield (kg ha^{-1})
Varieties				
V_1- JRJ 610	47.75	9.01	43.25	1048
V_2- SUIN 03	41.61	8.83	37.5	958.9
V_3- SUIN 037	50.42	9.58	42.16	1129
SEm±	1.01	0.18	1.52	22.24
CD (p=0.05)	2.98	0.54	4.47	65.46
CV (%)	7.54	7.02	12.9	10.4
Sowing windows				
S_1-First fortnight of November	53.83	9.74	46.33	1216
S_2-Second fortnight of November	51.42	9.09	41.22	1164
S_3- First fortnight of December	42.73	8.91	38.22	986.4
S_4- Second fortnight of December	38.37	8.82	38.11	814.5
SEm±	1.17	0.21	1.76	14.32
CD (p=0.05)	3.4	0.62	5.16	42.3
CV (%)	7.54	7.02	12.9	10.4
Interaction (V x S)	S	NS	NS	S

Table.4. Interaction effect of varieties and sowing windows on number pod plant^{-1}and seed yield (kg ha^{-1}) during *rabi* 2023-244

Treatments	S_1		S_2		S_3		S_4		Mean	
	First fortnight of November		Second fortnight of November		First fortnight of December		Second fortnight of December			
	No. of pods plant^{-1}	Seed Yield (kg ha -1)	No. of pods plant^{-1}	Seed Yield (kg ha -1)	No. of pods plant^{-1}	Seed Yield (kg ha -1)	No. of pods plant^{-1}	Seed Yield (kg ha -1)	No. of pods plant^{-1}	Seed Yield (kg ha -1)
V_1- JRJ 610	55.54	1220	54.61	1174	41.3	950	39.55	848.6	47.75	1048
V_2- SUIN 03	45.96	1125	43.16	1070	39.66	860	37.62	780	41.6	958.9
V_3- SUIN 037	60.15	1305	56.49	1248	47.25	1148	37.95	815	50.42	1129
Mean	53.83	1216	51.42	1164	42.73	986	38.37	814.5		
	SEm (±)		**CD (p=0.05)**		**CV (%)**					
Varieties(V)	2.98	22.24	1.01	65.46	7.5	12.8				
Sowing windows(S)	3.4	28.3	1.17	82.24	7.5	12.8				
V x S	2.03	27.65	5.9	79.62						
S x V	1.98	28.05	5.75	80.84						

and lower seed yield. Similar observations were recorded by Kaur *et al*. (2024), Choudhary *et al.* (2023) and Tripathi *et al*. (2013).

CONCLUSION

Based on the experimental findings it could be concluded that the sunhemp variety SUIN 037, recorded the highest number of pods plant^{-1}, number of seeds pod^{-1} and seed yield (kg ha^{-1}) over the other two varieties *i.e.,* JRJ 610 and SUIN 03. Sunhemp sown during first fortnight of November recorded higher number of primary branches plant $^{-1}$, LAI and yield attributes *i.e.,* number of pods plant^{-1}, number of seeds pod^{-1}, test weight (g) and seed yield(kg ha^{-1}). Similarly, very notable increase in seed yield was recorded with sunhemp variety SUIN 037 sown during first fort night of November, which is about 67.3% over sunhemp variety SUIN 03 sown at second fortnight of December.

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