Content list available at http://epubs.icar.org.in, www.kiran.nic.in; ISSN: 0970-6429

Indian Journal of Hill Farming

June 2018, Volume 31, Issue 1, Page 23-29

Study on Comparative Performance of Cowpea in Rice Fallows Areas as Influence by Dates of Sowing in Ri Bhoi District of Meghalaya

M. B. Singh[1*] • A.K. Singh[1] • Lala I.P.[1] • M.B. Devi[2]

[1]College of Post Graduate Studies (CAU, Imphal), Umiam, Meghalaya-793103

[2]Division of Horticulture, ICAR Research Complex for NEH Region, Umiam-793103, Meghalaya

ARTICLE INFO

Article history:
Received 26 July 2017
Revision Received 29 January 2018
Accepted 19 March 2018

Key words:
Cowpea, Sowing date, Yield and attributing traits

ABSTRACT

Pulses are the second important group of crops after cereals, providing high dietary protein (20 to 25%), along with rich supplement of calcium and iron. They play an important role to enhance soil fertility through biological nitrogen fixation and also pass on the benefits to associated non legume and subsequent crops. In NER of India, farmers mostly go for monocropping of rainfed rice. It is estimated that more than 5 lakh ha of low lying area in the region remain fallows after harvest of rice during rabi season. Such fallow land can be brought under cultivation, with short duration varieties of summer pulses such as cowpea. To identify suitable date of sowing of summer pulse (cowpea) for lowland rice fallow, the current study was undertaken. The present experiment revealed that cowpea should a choice of summer pulse for cultivation in lowland rice fallows because of its consistent performance in all sowing dates. It is also revealed the maximum grain yield was obtained when the crop is sown on 4th March.

1. Introduction

Rainfed agro-ecologies in India contribute around 65% of the net sown area, about 84-87% of pulses/minor millets, 80% of horticultural crops, 77% of oilseeds, 66% of cotton and 50% of cereals are cultivated under un-irrigated condition in the country (Singh et al. 2016). Thus, rainfed agro-ecologies are playing a major role in our food production and there by national economy. A majority of this area (about 11.7 M ha) remains fallow after rice harvest. Hence, there exists a vast scope for expansion of these areas (rice fallows) under low input and low water requiring pulse crops. However, residual moisture content in the soil profile after rice harvest could limit sowing of succeeding crops as these areas virtually ended up with drying, while some low-laying areas were still wet, that these areas could not be taken up for sowing immediately resulting in delayed sowing. Secondly, absence of reliable source of irrigation (due to lack of tube wells, water harvesting structures including farm ponds), life saving irrigation could not be possible (Praharaj and Blaise 2016).

In NER of India, farmers mostly go for rainfed rice farming and leave their land fallow after rice harvest. More than 5 lakh ha of such low lying areas are estimated as rice fallows in the NE States (Singh et al. 2014). Farmers mostly grow long duration rice cultivars and harvesting is sometimes delayed up to second week of December. Many low lying rice fields remain saturated even after rice harvest. Poor soil drainage accompanied with prevalence of low to very low temperature in later part of December restricts the scope of Rabi pulses. However, these rice fallows offer a good scope for diversified crop intensification through area expansion under short duration summer pulses. Pulses play an important role to enhance soil fertility which benefits component crops in association and subsequent crops in succession. Approximately 20-40% increase in yield of subsequent crops raised after pulses has been reported (Joshi 1998). Cultivation of pulses was also reported as an effective means of rehabilitating degraded soils and can contribute significantly to achieve twin objectives of increasing productivity as well as improving the sustainability of cereal-based cropping systems (Yadav et al. 1998). The soil and agro-climatic conditions of the NER of India are favourable

*Corresponding author: mbishonath@gmail.com

for pulses cultivation. With proper knowledge of optimum sowing time, pulses could be optimally grown in rice fallow areas of the NER. Cowpea (*Vigna unguiculata* L.), frenchbean or rajmash (*Phaseolus vulgaris* L.), blackgram (*Vigna mungo* L.) and greengram (*Vigna radiata* L.) etc. are the potential pulses for cultivation in rice fallows in NER (Ali 2014). However, sufficient information is not available on this very aspect. Keeping in view of the aspect the present experiment was be undertaken at the experimental Farm of College of Post Graduate Studies (CAU, Imphal), Umiam, Meghalaya during the summer season of 2016 with the objective to identify the best sowing date of summer pulse (Cowpea) in rice fallows of Meghalaya.

2. Materials and Methods

The investigation was carried out at the experimental Farm of the College of Post Graduate Studies (CAU, Imphal), Umiam in Ri-Bhoi district, Meghalaya during the summer 2016. Geographically the experimental site is located in North-East hill region of India at 25°41'N latitude, 91°54'E longitude and at an elevation of 950 m above the mean sea level (MSL). During crop season, at the experimental site a total rainfall of 625 mm was recorded. The weekly average of the maximum and minimum temperature during the cropping season ranged from 30.31-23.36^{o}C and 18.41-11.27^{o}C, respectively. The average relative humidity recorded during crop season was 66.92%. The weekly average of maximum and minimum temperature was recorded as 30.31^{o}C and 11.27^{o}C during 17th standard week in the month of April and 8th standard week in February, respectively. The highest rainfall of 111.7 mm was recorded in 21st standard week in the month of May.

The experiment consist of four date of sowing i.e., 19th February, 26th February, 4th March and 11th March, replicated thrice. The varieties used for the present investigation is Rambha/V 240. The observations on plant height (cm); LAI; dry matter accumulation (g per plant); root dry weight (g plant^{-1}); number of root nodules per plant; yield and yield attributing traits; days taken to 50% flowering, days taken to pod formation and days taken to first pod picking were recorded.

3. Results and Discussion

The plant height (cm) and leaf area index (LAI) are presented in Table 1. Higher plant height was observed in D_4 treatment (sowing date: 11th March) over rest of the treatment, except during harvest, where higher plant height was observed for treatment D_3 (4th March). Among the various treatment combinations no significant difference in plant height was observed between sowing dates D_1 and D_3 and between D_3 and D_4 at all the stages of growth (*viz.* 30, 45, 60 DAS and at harvest). But there was significant difference in plant height for crops sown on D_2 and D_3 in all the stages of crop growth. Further significant difference in plant height was observed for crop sown on D_1, D_4 and D_2, D_4 at all the stages, except on harvest stage where no significant difference in plant height was observed. Higher value of LAI was recorded from cowpea sown on 4th March at all the stages of growth over the other remaining dates of sowing. LAI recorded from 11th March sown crop while being at par with former recorded second higher value. Significant difference in LAI was observed between D1-D3 and D1-D4 at all the stages of growth. However, no significant difference in LAI was observed for crop sown on D3 and D4 at all the stages of growth. For treatment combinations D2-D3 and D2-D4 there were no significant difference in LAI at both 30 and

Table 1. Effect of sowing dates on plant height and LAI during various growth stages of summer cowpea

	Plant height (cm)				**LAI**		
Treatments	**30 DAS**	**45 DAS**	**60 DAS**	**Harvest**	**30 DAS**	**45 DAS**	**60 DAS**
D_1	23.00	36.07	47.20	70.27	0.78	1.62	3.36
D_2	23.07	34.47	49.33	68.22	1.37	1.79	3.53
D_3	26.73	38.67	52.87	72.72	1.56	1.97	4.01
D_4	31.53	41.27	56.93	70.33	1.51	1.95	3.98
Treatment combinations							
D_1-D_2	NS	NS	NS	NS	S	NS	NS
D_1-D_3	NS	NS	S	NS	S	S	S
D_1-D_4	S	S	S	NS	S	S	S
D_2-D_3	S	S	S	S	NS	NS	S
D_2-D_4	S	S	S	NS	NS	NS	S
D_3-D_4	NS	NS	NS	NS	NS	NS	NS
D_1: 19th February, D_2: 26th February, D_3: 4th March, D_4: 11th March							

45 days after sowing (DAS), however, at 60 DAS a significant difference in LAI was observed. In case of D1-D2 combination significant difference in LAI was only observed at 30 DAS. The analyzed result on plant dry weight (g $plant^{-1}$) is presented in Table 2. The difference in plant dry weight due to variation in sowing dates was non consistent at various stages of growth. Higher dry matter accumulation at harvest stage was recorded from 19th February sown crop. And significantly minimum dry matter accumulation at harvest was recorded from 11th March sown crop. Significant difference in dry matter accumulation was observed for D3-D4 combination at all stages of growth. For D1-D2 combination there was no significant difference in dry matter accumulation in all stages, except at harvest where significant difference in dry matter accumulation was observed. For the combinations D1-D4 and D2-D4 there were no significant difference in dry matter accumulation at both 30 and 45 DAS but at 60 DAS and at harvest significant difference in dry matter accumulation was observed. The root dry weight and number of root nodules per plant are presented in Table 3. Root dry weight follows similar trend as that of plant dry matter accumulation. The difference in root dry weight due to variation in sowing dates was also non consistent at various stages of growth. Higher root dry weight at harvest stage was recorded from 19th February sown crop. And significantly minimum root dry weight at harvest was recorded from 11th March sown crop. For treatment combinations D_1-D_2 and D_2-D_4 no significant difference in root dry weight was observed at all the stages of growth. While there was no significant difference in root dry weight at both 45 and 60 DAS for the combinations D_1-D_3, D_2-D_3 and D_3-D_4, however, at 30 DAS there was significant difference in root dry weight for these combinations.

Table 2. Effect of sowing dates on dry matter accumulation during various growth stages of summer cowpea

	Dry matter accumulation (g $plant^{-1}$)			
Treatments	**30 DAS**	**45 DAS**	**60 DAS**	**Harvest**
D_1	1.53	3.81	9.43	27.86
D_2	1.32	3.84	10.32	17.63
D_3	0.70	2.52	11.28	17.88
D_4	1.17	4.19	7.13	10.69
Treatment combinations				
D_1-D_2	NS	NS	NS	S
D_1-D_3	S	S	NS	S
D_1-D_4	NS	NS	S	S
D_2-D_3	S	S	NS	NS
D_2-D_4	NS	NS	S	S
D_3-D_4	S	S	S	S
D_1: 19th February, D_2: 26th February, D_3: 4th March, D_4: 11th March				

Table 3. Effect of sowing dates on root dry weight and number of root nodules at various growth stages of summer cowpea

Root dry weight $plant^{-1}$ (g)				**Number of root nodules $plant^{-1}$**		
Treatments	**30 DAS**	**45 DAS**	**60 DAS**	**30 DAS**	**45 DAS**	**60 DAS**
D_1	0.42	0.69	3.00	9.00	26.67	9.00
D_2	0.46	0.71	2.49	10.33	28.00	10.33
D_3	0.21	0.98	2.43	14.33	38.67	15.00
D_4	0.75	0.93	1.95	10.67	30.67	7.33
Treatment combinations						
D_1-D_2	NS	NS	NS	NS	NS	NS
D_1-D_3	S	NS	NS	S	S	S
D_1-D_4	NS	NS	S	NS	NS	NS
D_2-D_3	S	NS	NS	S	S	NS
D_2-D_4	NS	NS	NS	NS	NS	S
D_3-D_4	S	NS	NS	S	S	S
D_1: 19th February, D_2: 26th February, D_3: 4th March, D_4: 11th March						

Significantly higher number of root nodules was recorded from 4th March sown cowpea at all the stages of growth over all other remaining date of sowing. And minimum number of root nodules was recorded from 19th February sown crop at all the stages, except at 60 DAS where 11th March sown cowpea recorded minimum number of root nodules. Among the various treatment combinations, D_1-D_3 and D_3-D_4 recorded significant difference in number of root nodules at all the stages. While the combinations D_1-D_2 and D_1-D_4 recorded no significant difference in number of root nodules at all the stages. For D_2-D_3, there was significant difference in number of root nodules at all the stages, except at 60 DAS, where it was non-significant while for D_2-D_4 combination, significant difference in number of root nodules was recorded only at 60 DAS.

Phenological stages

Data on days taken to emergence, days taken to 50% flowering, days taken to pod formation and days taken to first pod picking are presented in Table 4. Out of all the four sowing dates, it has been observed that 19th February sown summer pulses took significantly maximum number of days to emergence, 50% flowering, pod formation and harvesting, respectively, over all other sowing dates. And minimum number of days to attain, the above penological stages was recorded from 11th March sown summer cowpea, except for days taken to emergence, where 4th March sown summer cowpea while being at par with 11th March sown cowpea recorded minimum number of days taken to emergence. There was significant difference in number of days taken to emergence, 50% flowering, pod formation and harvesting for the treatment combinations; D_1-D_3, D_1-D_4, D_2-D_3 and D_2-D_4. While D_1-D_2 combination, show no significant difference in number of days taken to attain the above phonological stages. For D_3-D_4 combination the difference in number of days taken to emergence and pod formation was non-significant, however, there was significant difference in number of days taken 50% flowering and days taken to harvesting.

Yield attributes of summer cowpea

The data on yield attributes of summer cowpea as affected by date of sowing are presented in Table 5. Number of pods per plant was found to be significantly higher when sowing was done on 4th March over all other remaining sowing dates. Minimum number of pods per plant was recorded from 19th February sown crops. Among various combinations of treatment D_1-D_2 and D_3-D_4 did not show any significant difference in number of pods per plant. While other remaining combinations (D_1-D_3, D_1-D_4, D_2-D_3 and D_2-D_4) show significant difference in number of pods per plant. Number of grains per pods did not varied significantly due to variation in date of sowing, however, relatively higher number of grains per pods was recorded from 4th March sown cowpea, relatively lower number of grains per pods was recorded from 4th March sown crops. Maximum grain weight per plant was recorded from 4th March sown cowpea over all the remaining date of sowing, minimum grain weight per plant was recorded from 26th February sown cowpea. Significant difference in grain weight per plant between different treatment combinations was recorded from only from D_1-D_3, while for the other remaining treatment combinations the difference in grain weight per plant was found non-significant. Significantly higher value of test weight was recorded for cowpea which was sown on 11th

Table 4. Effect of sowing dates on days taken to emergence, days taken to flowering, days taken to pod formation and days taken to pod picking of summer cowpea

	Days taken to emergence	**Days taken to flowering**	**Days taken to pod formation**	**Days taken to first pod picking**
Treatment				
D_1	10.67	46.33	55.00	88.33
D_2	9.67	42.67	51.00	85.33
D_3	7.33	36.67	42.00	78.00
D_4	7.67	33.33	40.67	67.33
Treatment combinations				
D_1-D_2	NS	NS	NS	NS
D_1-D_3	S	S	S	S
D_1-D_4	S	S	S	S
D_2-D_3	S	S	S	S
D_2-D_4	S	S	S	S
D_3-D_4	NS	S	NS	S
D_1: 19th February, D_2: 26th February, D_3: 4th March, D_4: 11th March				

March over all other remaining date of sowing. And 4th March sown cowpea recorded significantly lower value of test weight over all other date of sowing. Among the various combinations of treatment, only D_1-D_3 and D_1-D_4 combinations shows significant difference in test weight while the difference in test weight was found non-significant in other treatment combinations. Shelling percentage was found to be significantly higher when sowing was done on 4th March as compared to other remaining date of sowing. And significantly lower shelling percentage was recorded when sowing was done on 19th February. There was significant difference in shelling percentage in all the treatment combinations, except for the combination; D_3-D_4.

Discussion

It has been observed that cowpea (C1) has attained maximum plant height (72.72 cm, at harvest) when sown on 4th March (D4), however minimum plant height (68.22 cm, at harvest) for the crop was recorded when sown on 26th February (D2). The reduction in plant height in early sown crop (19th and 26th February) might be attributed to the prevailing lower temperature while in late sown crop (4th and 11th March), higher temperature during their vegetative growth period might have adversely affected plant development. This results obtained is well in agreement with the earlier finding of Chovatia et al. (1993), Aziz et al. (1996) and Tekale et al. (2011). Maximum plant and root dry weight was recorded when sown 19th, while minimum was recorded from 11th March sown (D_4) pulses. This might be due to low and high temperatures during first (D_1) and fourth (D_4) date of sowing, respectively during vegetative growth and reproductive period as dry matter accumulation is the function of both vegetative as well as reproductive growth. Higher temperature during 11th March (D4) decreases the duration of crops which leads to decrease dry matter accumulation per plant in all the 11th March sown summer pulses. Similar results were also cited by Sharma et al. (2008), Singh and Singh (2009) and Moniruzzaman et al. (2007).

Higher LAI was recorded from 4th March sowing (D_3) whereas maximum LAI, was recorded from fourth date of sowing, *i.e.* 11th March (D_4). And minimum LAI was recorded from 19th February (D_1) sowing. This is also due to optimum temperature and sunshine hours during third and fourth date of sowing, favouring development of higher photosynthetic surface area as compared to low temperature and less sunshine hour prevailing during first and second sowing which restrict the growth of leaf area. This result is in agreement with the findings of Sreelatha et al. (1999) and Saini and Negi (1998). Difference in number of root nodules per plant was observed due to different dates of sowing at all growth stages. Maximum number of root nodules per plant was recorded from 4th March (D_3). However, minimum number of root nodules per plant was observed, when they were sown on 19th February (D_1). This might be due to vigour's plant growth during third (D_3) and fourth (D_4) sowing date which assimilated higher photosynthetic product and partition of assimilates to nodules which helped in better root development. These results confirm the findings of Chovatia et al. (1993), Ram and Dixit (2000) and Singh and Singh (2009). Maximum number of days to attain various phenological stages (days taken to emergence, flowering, pod formation and pod picking) was recorded when were sown on 19th February (D_1). And minimum number of days to attain the same was recorded from 11th March sown crop. The reason for variation in days to first flowering may be attributed to variation in growing environment particularly the temperature due to different sowing times. Similar results were elucidated by Mozumder et al. (2003) and Jana (2005) in Frenchbean and Miah et al. (2009) in mungbean.

Among the yield attributing parameters number of pods per plant, test weight and shelling percentage were significantly influenced by dates of sowing. Higher number of pods per plant and shelling percentage were recorded under 4th March sowing (D_3) but it was at par with 11th March sowing (D_4). Lower number of pods per plant and shelling percentage were recorded under 19th February sowing (D_1). However maximum test weight for all the pulses was recorded when sowing was done on 11th March (D_4), while the minimum test weight was recorded from 19th February sowing (D_1). Number of grain per pods and grain weight per plant did not varied significantly due to different dates of sowing. This might be due to genetic character and not due to treatment effect. Variation in yield was observed due to variation in sowing dates. Maximum grain yield, biological yield and stover yield was recorded from 4th March sowing (D_3). This was due to various reasons such as higher plant population at D3 (4th March) as compared to other dates of sowing, higher number of pods per plant, number of grains per pods, grain weight per plant, test weight and shelling percentage. The results confirm the findings of Reddy et al. (2010) and Faroda et al. (1983.) The minimum grain yield, biological yield and stover yield was recorded from 26th February sowing. This was because of lower plant population at harvest and decrease yield attributing characters (pods per plant, grain per pods etc.) due to low temperature and soil moisture which restrict plant growth and development. Similar finding was also reported by Bhowmick et al. (2008), Tekale et al. (2011), Ihsanullah et al. (2002) and Jahan and Adam (2012).

Table 5. Effect of sowing date on yield attributes (number of pods plant^{-1}, number of grain pod^{-1}, grain weight plant^{-1}, test weight and shelling%) of summer cowpea

	Number of pods plant^{-1}	**Number of grain pod^{-1}**	**Grain weight plant^{-1} (g)**	**Test weight (g)**	**Shelling %**
Treatment					
D_1	11.2	7.30	7.73	107.40	43.10
D_2	12.5	7.43	8.33	119.40	48.80
D_3	20.7	7.77	9.53	112.33	65.73
D_4	18.9	7.23	8.47	123.60	59.27
Treatment combinations					
D_1-D_2	NS	NS	NS	S	S
D_1-D_3	S	NS	S	NS	S
D_1-D_4	S	NS	NS	S	S
D_2-D_3	S	NS	NS	NS	S
D_2-D_4	S	NS	NS	NS	S
D_3-D_4	NS	NS	NS	NS	NS
D_1: 19th February, D_2: 26th February, D_3: 4th March, D_4: 11th March					

Conclusion

On the basis of the findings of the above experiment it can be concluded that cowpea is a choice of summer pulse for cultivation in lowland rice fallows because of its consistent performance in all sowing dates. Maximum grain yield was recorded when the crop was sown on 4th March.

References

Ali M (2014). Improving productivity of pulses in rice fallows. Indian Farming 63:17-19

Aziz MA, Rahman MM (1996). Response of Nabin chickpea to different dates of sowing. Bangladesh J Scientific Industrial Res 31:103-110

Bhowmick MK, Sadhukhan R, Saha PK (2008). Response of new mungbean genotypes to sowing time during spring-summer in West Bengal. J Crop Weed 4: 1-3

Chovatia PK, Ahlawat RPS, Trivedi SJ (1993). Growth and yield of summer greengram (*Phaseolus radiata*) as affected by different dates of sowing, rhizobium inoculation and levels of phosphorus. Ind J Agron 38:492-494

Faroda AS, Tomer DPS, Singh RC (1983). Performance of mungbean varieties under different sowing dates during summer season. Ind J Agron 28:144-147

Ihsanullah JA, Taj FH, Khan IA, Khan N (2002) Effect of sowing dates on yield and yield components of mash bean. *Asian J Plant Sci* 1:622-624

Jahan N, Adam MG (2012). Growth and yield performance of *Bari* mung-5 under different time of sowing. J Bangladesh Acad Sci 36:227-231

Jana JC (2005). Effect of sowing date and variety of French bean on seed yield and quality. Seed Res 33:111-11.

Joshi PK (1998). Performance of grain legume in the Indo Gangetic plain. In: Kumar Rao, JVDK, Johansen C, and Rego TJ, (eds.). Residual effects of legumes in rice and wheat cropping systems of the Indo-Gangetic Plain. ICRISAT

Miah MAK, Anwar, MP, Mahfuza B, Juraimi AS, Islam MA (2009). Influence of sowing date on growth and yield of summer mungbean varieties. J Agri Social Sci 5(3): 73-76

Moniruzzaman M, Rahman SML, Kibria MG, Rahman MA, Kaisar MO (2007). Performances of vegetable frenchbean as influenced by varieties and sowing dates in rabi season. Int J Sustainable Crop Prod 2(5):69-73

Mozumder SN, Moniruzzaman M, Islam MR, Alam SN (2003). Effect of planting time and spacing on the yield performance of bushbean (*Phaseolus vulgaris* L.) in the eastern hilly area of Bangladesh. Legume Res 26: 242-247

Praharaj CS, Blaise D (2016). Intercropping: An approach for area expansion of pulses. Ind J Agron 61:113-121

Ram SN, Dixit RS (2000). Effect of dates of sowing and phosphorus on nodulation, uptake of nutrients and yield of summer greengram (*Vigna radiata* L. Wilczek). Crop Res Hisar 19: 414-417

Reddy MM, Padmaja B, Reddy DRR (2010). Performance of frenchbean at different dates of sowing and plant densities in Telangana region of Andhra Pradesh. J Food Legumes 23: 54-56

Singh A.K., Chakraborti M, M. Datta (2014). Improving rice-based cropping pattern through soil moisture and integrated nutrient management in mid tropical plain zone of Tripura, India. Rice Sci 21(5): 299-304.

Singh NP, Praharaj CS, Sandhu JS (2016). Utilizing untapped potential of rice fallow of East and North-east India through pulse production. Ind J Gen Plant Breeding 76:388-398

Singh S, Singh G. (2009). Effect of sowing dates on growth and yield of mungbean genotypes during summer season. J Food Legumes 22:305-307

Sharma VK, Pathania P, Sharma GD (2008). Response of frenchbean (*Phaseolus vulgaris* L.) varieties to sowing dates and plant density in cold desert region. Legume Res 31:230-231

Tekale CD, Patel DD, Dongare RS, Patil SD (2011). Performance of green gram (*Vigna radiata* L.) cultivars under different dates of sowing. J Life Sci 8: 415-416.

Yadav RL, Dwivedi BS, Gangwar KS, Prasad K (1998). Overview and prospects for enhancing residual benefits of legumes in rice and wheat cropping systems in India. In: Rao, JVDKK, Johansen C, Rego,TJ. (eds) Residual effects of legumes in rice and wheat cropping systems of the Indo-Gangetic Plain, pp 207-225