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Evaluation of chickpea varieties for rice fallows of Imphal valley in Manipur

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Abstract
In rice-based cropping systems, chickpea is a viable crop for agricultural diversification and enhancing production. As a result, a field experiment was carried out in 2012-13 and 2013-14 to assess the performance of chickpea cultivars under rice fallow conditions following lowland rice harvest. In rice fallow conditions, ten chickpea (*Cicer arietinum* L.) cultivars were assessed. Pant G-186 (26.75) produced significantly more pods per plant than the other cultivars, followed by JG-16 (25.75) and DCP 92-3 (21.73). Shubra had the highest 100 seeds weight (34.73 g), followed by JG-14 (22.37g). With 1284 kg/ha, Shubra outperformed the other cultivars, followed by Rajas (1284 kg/ha) and JG-16 (1176 kg/ha). Except for JG-14, which matured in around 122 days, the majority of the cultivars matured in about 129-137 days. Thus, the study demonstrated the potential for chickpea growing in lowland rice fallow with acceptable technology in Imphal valley of Manipur.

Keywords: Rice-fallow, chickpea, varieties, flowering, maturity

Introduction
In India, more than 11 million acres of land remains fallow after the harvest of kharif rice (Subbarao *et al*., 2001) [1]. This could be due to biotic, abiotic, biophysical, and socioeconomic restrictions, such as moisture stress during planting and crop growth, a lack of suitable winter crop types, and so on (Ali and Kumar, 2009) [2]. India, on the other hand, produces enough food grains but not enough pulses and oilseeds. Because it requires relatively few inputs, restores soil fertility, and has adequate residual soil moisture to grow a pulse crop, this rabi rice fallow land has emerged as a major prospective niche for pulse production as well as agricultural intensification (Ali, 2014) [3].

Growing long-duration rice varieties in most of Manipur causes problems with seeding existing chickpea genotypes. As a result, during the final phases of growth, chickpea is subjected to heat stress, which contributes to reduced productivity. Furthermore, short winter duration, variable rainfall, low residual soil moisture, and rapid water table decline in rabi season cause terminal heat stress, early, mid, and terminal drought, particularly during flowering and pod filling stages of traditional chickpea varieties, resulting in flower drop, poor pod formation, and significant yield loss. In this context, high yielding short duration varieties should be encouraged to boost farming resilience. There is potential for increasing the area under pulse crops such as chickpea (*Cicer arietinum* L) in rice fallows in India's North Eastern region, where a large percentage of the field remains fallow following the kharif season rice harvest.

Chickpea is an important pulse crop that is cultivated mostly on residual soil moisture and is a significant source of vegetable protein. Chickpea is tailored to local climatic and soil fertility conditions, in addition to fixing atmospheric N and benefiting the subsequent crop with residual nitrogen in soil. Growing a second crop (pulse) after rice improves soil structure by using appropriate seeding and tilling procedures. Conservation tillage is more beneficial to the ecology than conventional tillage (Blanco-Canqui *et al*. 2013) [4]. Gangwar *et al*. (2006) [5] reported a higher yield of pulse after wet season (kharif season) rice with reduced tillage. Minimum tillage combined with crop residue management has been shown to reduce soil water evaporation, sealing, and crusting (Gangwar *et al*. 2006) [5].

Early maturing chickpea cultivars may avoid terminal moisture stress in rice fallow and convert these mono-cropped areas into double cropped areas, increasing legume yield and sustaining rice-based system productivity. Manipur, one of India's north-eastern states, has likewise achieved self-sufficiency in a variety of sectors by growing food production exponentially. However, it has not yet addressed the issue of chronic food insecurity at the family level, as well as year-to-year changes in food production. Only rice production, which accounts for more than 90% of total food grain production, is self-sufficient in the state. However, the state of pulse production is dismal. The share of total pulse production, including oil seed production, was less than 1%. Due to a lack of high yielding short duration pulses with suggested production methods, the state presently faces a significant scarcity in pulse production. Therefore, a field experiment was conducted to assess the performance of various chickpea varieties in rice fallow under reduced tillage conditions.

Materials and Methods

A field experiment was undertaken during 2012-13 and 2013-14 at Research Farm, Andro, Central Agricultural University, Imphal, which is located between 24°76 North latitude and 94°05 East longitude at a height of 900 meters above mean sea level (MSL) in Manipur's Imphal East district. The soil at the experimental site had the texture of clayey loam, was acidic in soil reaction, high in organic carbon, medium in available nitrogen, low in available phosphorus, and high in available potassium. The climate at the experimental site is subtropical. During the crop growing season, the mean maximum temperature ranged from 19.85 °C to 30.74 °C and the lowest temperature ranged from 1.17 °C to 17.21 °C Crop received 205.4 mm total rainfall (Table 1). The experiment used a randomized block design with ten chickpea types (JG-14, Pant G-186, BGM-547, Rajas, JG-11, Pusa-372, DCP 92-3, Shubra, JG-16, and GCP-105) that were replicated three times. The seeds were sown on a 4 m x 2.4 m plot. Following the harvest of kharif rice, chickpea genotypes were seeded in rows 30 cm apart. Fertilizer was applied during land preparation at a rate of 20:40:40 kg/ha N: P_2O_5:K_2O. At crop harvest, data on phenology and yield attributes were collected from 5 plants chosen at random from each plot. For optimum growth, the crop was grown with residual soil moisture with one life saving irrigation at the flowering stage.

The experimental data for each parameter of investigation were statistically analyzed using the analysis of variance technique, and their significance was assessed using the "F" test (Gomez and Gomez 1984) [6]. To examine differences between treatment means, the standard error of means (S.Em±) and least significant difference (LSD) with 5% probability (p=0.05) were calculated for each parameter studied.

Results and Discussion

Growth attributes

The tallest plants were Pant G-186 (30.4 cm), followed by Shubra (28.0 cm) and JG-14 (27.2 cm). Pusa-372 (21.1 cm) was the shortest chickpea plant, followed by GCP-105 (21.3cm). In terms of days to 50% flowering and days to maturity, there was a notable difference across chickpea varieties. Pant G-186 required the fewest days to reach 50% flowering (63) and was on par with Pusa-372 (63.3). JG-14 matured first (122 days), followed by the other varieties in 122 to 137 days (Table 2).

Yield attributes and yield

The yield and yield variants of the varieties differed significantly. Variety Pant G-186 produced the most pods per plant (26.1), followed by JG-16 (25.6). Variety BGM-547 produced the fewest pods per plant (14.9). The100 seeds weight varied significantly amongst varieties, ranging from 15.6 g to 34.7 g. Variety Subhra had the highest 100 seed weight of 34.7 g, while Pusa-372 had the lowest 100 seed weight of 15.6 g.

The yield potential of these varieties ranged from 1515 to 744 kg/ha. Shubra had the highest yield potentiality (1559 kg/ha), followed by Rajas (1284 kg/ha), and Pusa-372 had the lowest yield (744 kg/ha). Having a higher number of primary branches per plant, pods per plant, and 100 seed weight resulted in a yield advantage in these chickpea varieties (Table 3).

Table 1: Meteorological data during the crop growing season.

Std. Week	Rainfall (mm)	Temperature°C		Std. Week	Rainfall (mm)	Temperature °C	
		Max.	Min.			Max.	Min.
44	5.20	28.07	13.83	5	0.10	25.69	7.19
45	83.10	24.56	14.70	6	0.20	28.09	6.86
46	0.00	28.71	12.11	7	1.40	27.54	7.27
47	0.00	27.83	12.76	8	0.00	28.91	7.91
48	0.00	25.37	5.96	9	0.00	30.74	7.50
49	0.00	23.86	6.30	10	0.00	29.8	7.21
50	0.00	19.93	7.23	11	7.50	28.63	12.34
51	0.00	22.83	3.27	12	11.00	27.96	11.27
52	0.00	23.50	2.59	13	13.30	28.76	14.89
1	0.00	25.51	2.64	14	41.10	28.54	13.77
2	0.00	19.85	1.17	15	4.00	29.89	17.21
3	0.00	24.10	3.53	16	34.60	26.81	15.01
4	0.00	24.36	3.76	17	3.9	29.67	15.63

Table 2: Plant height, days to 50% flowering and maturity (days) of different chickpea varieties

Varieties	Plant height (cm)	50% flowering (Days)	Maturity (Days)
JG-14	27.2	71.7	122.3
Pant G-186	30.4	63.0	133.3
BGM-547	26.0	82.0	129.3
RAJAS	24.2	78.0	129.7
JG-11	25.0	74.0	129.0
Pusa-372	21.1	63.3	137.7
DCP 92-3	23.0	78.3	131.0
SHUBRA	28.0	76.0	132.0
JG-16	22.2	69.0	134.7
GCP-105	21.3	68.0	132.3
S.Em(±)	0.2	3.4	2.9
CD(p=0.5)	0.7	10.0	8.5

Table 3: Yield attributes and yield of different varieties of chickpea

Treatment	Pods per plant	100 seeds weight (g)	Yield (kg/ha)
JG-14	13.9	27.4	1083.9
Pant G-186	26.1	17.4	1115.8
BGM-547	14.9	24.7	961.4
RAJAS	16.3	25.9	1283.9
JG-11	15.5	26.2	1079.2
Pusa-372	19.7	15.6	744.7
DCP 92-3	21.3	16.0	847.2
SHUBRA	16.3	34.7	1515.3
JG-16	25.6	20.0	1176.4
GCP-105	17.3	19.9	1097.8
S.Em(±)	0.3	1.2	60.2
CD0.5	0.7	3.6	178.5

Conclusion

Based on maturation and yield levels, the chickpea varieties Shubra and Rajas were deemed to be promising and should be promoted for cultivation in rice-fallow of Manipur.

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