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Effect of Row Proportions On Yield Components and Yield Of Intercropping Wheat (*Triticum aestivum* L.) + Chick Pea (*Cicer arietinum* L.) Under Rainfed Conditions

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ABSTRACT
To study the influence of row proportions on yield components and yield of rabi crops under different intercropping systems, an experiment was laid out in a randomized complete block design with three replications. Wheat (GW-273) was sown as sole crop and intercropped with chickpea (Vaibhav) in different proportions viz; 1:1, 2: 1 and 3: 1. It was found that the effective numbers. of tillers (m^2), plant height (cm), LER (Land Equivalent Ratio), spike length (cm), numbers of grains per spike and grain weight(g), seed yield (kg), straw yield (kg) and harvest index (%) of wheat varied significantly among intercropping systems. The highest seed yield of 1255 kg ha^{-1} for wheat + chickpea (1255 kg ha^{-1}) was found as compared to sole crop of wheat which was recorded as 1132.45 kg ha^{-1}.
Key words :*Intercropping, wheat, chickpea, yield components*

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INTRODUCTION

The practice of growing two or more crops simultaneously in the same field is called intercropping. It is a common feature in traditional farming of small landholders. It provides farmers with a variety of returns from land and labour, often increases the efficiency with which scarce resources are used and reduces the failure risk of a single crop that may be susceptible to environmental and economic fluctuations. The objective of enhanced cropping intensity can also be achieved through intercropping. The need for increased production of pulses can also be fulfilled through their intercropping in wheat. Besides intercropping of compatible crops, use resources very efficiently and provide yield advantage over sole crops. According to Malik *et al.* (1998), inter cropping of lentil, gram and rapseed in wheat under rainfed conditions.

Intercropping has gained interest because of potential advantages with improved utilization of growth resources by the crops and improved reliability from season to season. When a legume is grown in association with another crop (intercropping), commonly a cereal, and the nitrogen nutrition of the associated crop may be improved by direct nitrogen transfer from the legume to cereal (Giller and Wilson, 1991). Legumes, with their adaptability to different cropping patterns and their ability to fix nitrogen, may offer opportunities to sustain increased productivity (Jeyabal and Kuppuswamy, 2001). Therefore, productivity normally is potentially enhanced by the inclusion of a legume in a cropping system (Maingi *et al.,* 2001). Legume intercrops are also potential sources of plant nutrients that complement/supplement inorganic fertilizers (Banik and Bagchi, 1994; Ofori and Stern, 1987). In addition, legume intercrops are included in cropping systems because they reduce soil erosion (Giller and Cadisch, 1995) and suppress weeds (Exner and Cruse, 1993).The objective of this study was therefore to investigate the feasibility and yield advantage of intercropping different leguminous (chickpea) crops in wheat under rainfed conditions.

MATERIALS AND METHODS

Field experiment was conducted during winter (rabi) season of 2014-15 and 2015-16 under the Project "Niche Area of Excellence - Farm Mechanization in Rainfed Agriculture (NAE-FMIRA)" being operated at IGKV, Raipur (C.G.). The location of the experimental site was Instructional Farm of Indira Gandhi Agricultural University, Raipur (CG) located between 21.4^0 N latitude and 81.4^0 E longitudes with an altitude of 314 m above mean sea level. The general climate of the experimental site is classified as sub-humid with hot summer and mild winters. It comes under the Chhattisgarh Plains agro-climatic sub zone of seventh agro-climatic region of India i.e. Eastern Plateau and Hills. The average annual rainfall is about 1320 mm, which is largely contributed by southwest monsoon. Nearly, 85 – 90 percent of total rainfall is received from June to September. The maximum temperature rises upto 45^0C during summer season, whereas, the minimum temperature falls to down 5 - 6^0 C during winter season. Atmospheric humidity is normally higher during June to September and thereafter it declines in winters. The soil of the experimental site is characterized as silt clay texture, locally known as "*Dorsa*". It falls under *Alfisols* and belongs to mixed Hyperthermic udic Haplastalfs. Mostly, *Alfisols* are bunded and leveled and occur generally, on mid land situation of landscape in Chhattisgarh plains. Initial soil samples were collected using a screw auger to a 15–20 cm depth. Organic carbon and available N, P and K were analyzed adopting a method outlined by Jackson (1973). pH of 7.12 (1:2.5 soil and water suspension), electrical conductivity 0.52 dSm-1 (1:2.5 soil and water suspension) and organic carbon level of 5.60% and available N, P and K were observed to be 241, 19.44 and 330 kg ha-1, respectively. The field was prepared using two operation of cultivator followed by single operation of rotavator. The intercrop was sown by modified seed drill (Fig.-1). The experiment was laid out in a randomized complete block design (RCBD) with three replications, four treatment consisted of sole wheat and intercropping of chickpea in 1:1, 2:1 and 3:1 row proportion (Table 1). The row-to-row distance was kept at 30 cm and plant to plant at 10 cm in all the treatments. The sowing was done just after the harvesting of paddy crop. Wards After, no irrigation was applied up to harvest of crop. Land preparation was carried out by tractor ploughing followed by harrowing. The fertilizer schedule was 60:40:40 kg N, P_2O_5 and K_2O per hectare for mono-cropped and intercropped wheat and 20:40:20 (N, P_2O_5, and K_2O) for mono-cropped chickpea. Proportionate fertilizers were applied to intercropped chickpea along the rows. Two-third of nitrogen in the form of urea (46-0-0) and the whole amount of P_2O_5 and K_2O in the form of single super phosphate (0-16-0) and muriate of potash (0-0-60) respectively, were applied as basal and remaining one-third nitrogen was top dressed 22 days after sowing (DAS) at crown root initiation stage of wheat. The total amount of N, P_2O_5 and K_2O in the form of urea, SSP and MOP was applied as basal in chickpea. Recommended agronomic package of practices was followed (Mohsin et al., 1986). Approved varieties of wheat (GW-273) and of chickpea (Vaibhav) were used as test crop. Planting was done with multi crop seed drill on 2 November 2015.

Table-1 : Treatment details of the experiment

Treatment		**Intercrop**	**Row proportions**
T1		Wheat + chickpea	1:1
T2		Wheat + chickpea	2:1
T3		Wheat + chickpea	3:1
T4		Sole crop wheat	—

The seed rates of wheat as 100 kg ha^{-1} and chickpea as 75 kg ha^{-1} respectively were kept. The wheat seeds were treated with bavistin (2.5 g per kg of seeds), chickpea seeds with rhizobium culture respectively. All other cultural practices were kept uniform for all the treatments. Harvesting was done manually in March 2014 with the help of sickles, leaving border rows (single row from each side).

DATA ANALYSIS

Five wheat plants from each wheat sole crop and wheat-chickpea intercrop plot were dug up at 50 days after emergence (before flowering, which occurred approximately 55 DAS). The yield attributes and yield showed significant variation due to adoption of different row proportion (table-2). The data on plant effective numbers of tillers (m^2), plant height (cm), Land Equivalent Ratio (LER), spike length (cm), number of grains per spike and grain wt (g), grain yield, straw yield and harvest index were recorded (Fig 2). For dry weight determination, the samples were oven-dried at 70^0 C temperature to a constant weight. Land equivalent ratio was calculated as follows (Willey, 1979):

$$LER = (LERa + LERb) = \left[\frac{Yab}{Yaa} + \frac{Yba}{Ybb}\right]$$

Where LERa and LERb are the partial LER of crop wheat and chickpea, respectively.

Fig.-1 : Observation taken for wheat-chickpea intercrop

RESULTS AND DISCUSSION

In case of Sole wheat (T_4) the crop performance parameters including yield (1132.45 kg ha^{-1}), straw yield (1637.67 kg ha^{-1}), 1000 grain weight (37.23 g), grain spike $^{-1}$ (47.75), effective No. of tillers (432 m^2), plant height (77.39 cm), Land Equivalent Ratio (LER) 1.07, and spike length (10.40 cm) were found significantly higher as compared to inter cropping of wheat + chickpea with 1:1

Table-2 : Effect of different row proportions on yield components of wheat-chickpea intercropping systems

Treatment	No. Of effective Tillers m2	Plant heigh t	LER	Spike length	Grain spike-1	1000 grain wt	Seed yield	Straw Yield	Harvest index
		(cm)		(cm)		(g)	Kg/ha	Kg/ha	
	313.00								
T1 -Wheat + chickpea (1:1)	328.00	73.32	1.03	7.66	43.05	33.52	964.33	1464.33	0.72
T2 -Wheat + chickpea (2:1)	456.33	74.89	1.05	8.78	45.99	35.97	1053.63	1545.67	0.79
T3 -Wheat + chickpea (3:1)	432.00	79.75	1.53	10.54	49.58	39.33	1255.33	1755.33	0.81
T4-sole crop wheat	60.05	77.39	1.07	10.40	47.75	37.23	1132.45	1637.67	0.81
C.D. at 0.05%	17.02	3.08	0.32	0.87	1.01	2.07	79.54	79.54	N/S
SE(m)	24.07	0.87	0.09	0.25	0.29	0.59	22.55	22.55	0.01
SE(d)	7.60	1.23	0.13	0.35	0.40	0.83	31.89	31.89	0.02
C.V.		1.97	13.44	4.34	1.04	2.73	3.47	2.44	2.55

row proportion (T_1) and wheat + chickpea with 2:1 row proportion (T_2) but these parameters excepts index were found little inferior to that of intercropping wheat + chickpea with 3:1 row proportion (T_3) but deference was non significant. Harvest Index for T_3 and T_4 was found non-significant at different growth stage of crop growth. Among intercropping treatments, T_3 - wheat + chickpea 3:1 row ratio recorded highest seed yield (1255.33 kg/ha), straw yield (1755.33 kg/ha), 1000 grain weight (39.33 g), Grain/spike (49.58), Effective No. of tillers (456.33 m^2) , plant height (79.75 cm), spike length (10.54 cm). Similar results were found by Singh et al. (1992) and Singh et al. (1988).

CONCLUSION

The productivity of sole crop of wheat was higher in comparison to wheat–chickpea (1:1) and wheat–chickpea (2:1) row proportion intercropping pattern. Intercropping system was found to be beneficial for wheat –chickpea (3:1) row proportion intercrop. Wheat-chickpea (3:1) intercrop gives higher yield as compare to sole crop of wheat in terms of LER and productivity.

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