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Nutrient and weed management practices effect on growth, nodulation, yield, economics and energetics of Chickpea (*Cicer arietinum* L.)

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Abstract
Field experiment was carried out at Research Farm, Indira Gandhi Krishi Viswavidyalaya, Raipur (Chhattisgarh) during Rabi seasons of 2013-14 and 2014-15 to study the effect of nutrient management and weed management practices on yield and nutrient status. The highest crop stand was under 100% RDF *i.e.* 17.35 and 18.1 during 2013-14 and 2014-15, respectively with mean of 17.73 and in untreated control *i.e.* 18.48 and 18.81 during 2013-14 and 2014-15, respectively with mean of 18.65.The maximum number of nodules and nodule dry weight were obtained under 100% RDF. Pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1}produced the maximum number of nodules and nodule dry weight. Application of 125% RDF gave the maximum net returns (₹44282ha^{-1} and ₹58688 ha^{-1}during 2013-14 and 2014-15, respectively with mean of ₹51485ha^{-1}) and benefit: cost ratio (3.03 and 3.45 during 2013-14 and 2014-15, respectively with mean of 3.24). Pre-emergence application of metribuzin 0.4 kg ha^{-1}+ oxyfluorfen 0.3 kg ha^{-1} gave the maximum net returns (₹ 61176 ha^{-1} and ₹ 75130 ha^{-1} during 2013-14 and 2014-15, respectively with mean of ₹ 68153 ha^{-1}) and benefit: cost ratio (3.65and 3.98 during 2013-14 and 2014-15, respectively with mean of 3.82). The maximum energy intensiveness (2.07 and 2.20 during 2013-14 and 2014-15, respectively with mean of 2.13) was under application of 125% RDF. Amongst the weed management practices, the maximum energy intensiveness (2.39 and 2.45 during 2013-14 and 2014-15, respectively with mean of 2.42) was under pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1}.

Keywords: Chickpea, Nodules, Rhizobium, Yield, Economics, Energetics

Introduction
Pulses are the important food crop of the world because it provides good source of vegetable dietary protein, mostly in areas where economy does not support large scale production and utilization of animal protein. (Peerzada *et al*., 2014) [6]. Chickpea is one of the best sources of pulse in India. It is an excellent source of vitamins B6, vitamin C and Zinc. In India, it's area, production and productivity are 8.56 mha, 7.35 mt and 859 kg/ha, respectively (AICRP, 2010). In Chhattisgarh, chickpea is also one of the important pulses and occupies an area of 375.76 thousand ha with production and productivity of 402.06 thousand ton and 1070 kg/ha, respectively (Anonymous, 2013) [2].

Chickpea is a very poor competitor to weeds. Manual weeding is the common practice by farmers. But now a days there is scarcity of labourers and it is time consuming. Herbicides controls broad spectrum of weed species in pulses effectively. Usage of herbicides in proper way will control weeds during critical period of crop-weed competition. Fertilizers also play significant role in boosting up the production of pulses. Nitrogen is an essential macronutrient needed by all plants to thrive. Phosphorus and potassium are the nutrients required in large quantity for optimum growth and yield of pulses. Herbicides may change the growth and nodulation of crop.

The impact of nutrient doses and herbicides on nodulation, rhizobial population, economics and energetics of chickpea has not been evaluated. So there is need to know the effect of herbicides and nutrient doses on nodulation, rhizobial population, economics and energetics of chickpea. In light of the above the field experiment was carried out to find out the suitable herbicide and economical nutrient dose.

Materials and Methods
The present investigation on 'Effect of nutrient management and weed management practices

on yield, nutrient content and uptake by late sown chickpea in rice based cropping system' was carried out during *Rabi* seasons of 2013-14 and 2014-15 at the Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) located between 21°4' N latitude and 81°39' E longitude with an altitude of 298 metre above mean sea level having sub tropical humid climate. The experimental soil was clayey (vertisol) with pH 7.12, EC 0.20 m mhos m^{-1}, low in available nitrogen (212.6 kg N ha^{-1}), medium in available phosphorus (12.50 kg P ha^{-1}), high in available potassium (300.3 kg K ha^{-1}) and organic carbon (0.48%). The experiment was laid out in split plot design with three replications with a plot size of 4.8 m x 4.0 m. Main plot consisted of nutrient management *viz* (1) Recommended Dose of Fertilizers (20 kg N, 50 kg P_2O_5 and 30 kg K_2O ha^{-1}) (2) 125% RDF (25 kg N, 62.5 kg P_2O_5 and 37.5 kg K_2O ha^{-1}) (3) 150% RDF (30 kg N, 75 kg P_2O_5 and 45 kg K_2O ha^{-1}). Sub plot consisted of seven weed management practices *viz.* (1) Metribuzin 0.4 kg/ha + Oxyfluorfen 0.3 kg/ha as PE (2) (Imazethapyr 35% + Imazamox 35%) 100 g/ha as PoE (3) (Pendimethalin 30% EC + Imazethapyr 2%) 1.0 kg/ha as PE (4) Sulfentrazone 300 g/ha as PE (5) Oxyfluorfen 0.3 kg/ha as PE fb Imazethapyr 50 g/ha as PoE (6) Imazethapyr 50 g/ha as PE fb Metribuzin 0.3 kg/ha as PoE (7) Untreated control. Variety 'JG-226'

Microbiological estimations with respect to rhizobial count in the soil samples were done by dilution plate method (Subba Rao, 1988) [7].

Rhizoidal population density in the YEMA broth was also estimated by using the same formula

Number of rhizobia g^{-1} of oven dry soil

$$= \frac{\text{No of colony forming units (CFU) x dilution}}{\text{weight of soil sample x aliquot taken}} X\ 100$$

Cost of cultivation (≠ha^{-1}) of each treatment was calculated considering the prevailing charges of agricultural operations and market price of inputs involved.

Gross return (≠ha^{-1}) = (Seed yield x price) + (Stover yield x price)

Net returns were obtained by deducting cost of cultivation from gross return.

Net returns (≠ha^{-1}) = Gross return (≠ha^{-1}) - Cost of cultivation (≠ha^{-1})

$$\text{Benefit: cost ratio} = \frac{\text{Gross returns (≠ha}^{-1}\text{)}}{\text{cost of cultivation (≠ha}^{-1}\text{)}}$$

$$\text{Energy use efficiency (q MJ}^{-1}\text{ X 10}^{-3}\text{)} = \frac{\text{Total produce (q)}}{\text{Energy input (MJ X10}^{-3}\text{)}}$$

$$\text{Energy output-input ratio} = \frac{\text{Total energy output}}{\text{Total energy input}}$$

Paneswar and Bhatnagar, 1994-

$$\text{Energy productivity (kg MJ}^{-1}\text{ ha}^{-1}\text{)} = \frac{\text{Mean seedyield (kg ha}^{-1}\text{)}}{\text{Total energy input (MJ)}}$$

Burnett (1982)-

$$\text{Energy intensiveness (MJ ≠}^{-1}\text{)} = \frac{\text{Total energy output (MJ)}}{\text{Total cost incurred (≠)}}$$

Results and discussion

Crop stand (per m row)

Crop stand was recorded at 14 DAS during both the years as well as on mean data basis, and data related to crop stand are presented in Table1. Crop stand was significantly influenced by nutrient and weed management practices.

The highest crop stand was under 100% RDF *i.e.* 17.35 and 18.1 during 2013-14 and 2014-15, respectively with mean of 17.73.

Among weed management practices, crop stand was highest in untreated control *i.e.* 18.48 and 18.81 during 2013-14 and 2014-15, respectively with mean of 18.65 which was at par with imazethapyr 35% + imazamox 35% 100 g ha^{-1} as PoE during 2013-14 and 2014-15.

Interaction between nutrient and weed management on crop stand was found non-significant.

Plant height (cm)

The data pertaining to plant height of chickpea as influenced by nutrient and weed management practices are presented in Table 1. In general, the plant height increased with advancement in crop age of chickpea upto harvest in all treatments.

There was significant difference due to nutrient management on plant height at all growth stages. 150% RDF showed highest plant height. Among weed management practices, higher plant height was observed under oxyfluorfen 0.3 kg ha^{-1} as PE fb imazethapyr 50 g ha^{-1} as PoE which was comparable to post-emergence application of (imazethapyr 35% + imazamox 35%) 100 g ha^{-1} during both the years as well as on mean data basis. The lowest plant height was noted under imazethapyr 50 g ha^{-1} as PE fb metribuzin 0.3 kg ha^{-1} as PoE.

Interaction between nutrient and weed management on plant height was non-significant at all intervals, during both the years and on mean data basis.

Number of nodules plant^{-1}and nodule dry weight (mg plant^{-1})

Data related to number of nodules $plant^{-1}$ presented in Table 1.

Nutrient management showed significant difference on number of nodules $plant^{-1}$and nodule dry weight of chickpea, during both the years and on mean data basis The maximum number of nodules and nodule dry weight were obtained under 100% RDF during both the years as well as on mean data basis and it was comparable to 125% RDF during both the years as well as on mean data basis.

Among weed management practices, pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1}produced the maximum number of nodules and nodule dry weight which was at par with oxyfluorfen 0.3 kg ha^{-1} as PE fb imazethapyr 50 g ha^{-1} as PoE during both the years as well as on mean data basis.

The interaction between nutrient and weed management practices was found non significant on number of nodules and nodule dry weight.

Rhizobium population

Rhizobium population (x 10^6 g^{-1} soil) of chickpea field was estimated and data are presented in Table1. Rhizobium population was increased upto 45 DAS and then decreased at 60 DAS.

Nutrient management showed significant effect on rhizobium population. Significantly higher rhizobium population was observed in 100% RDF than 125 and 150% RDF. The rhizobium population was decreased with increase in nutrient level from 100 to 150% RDF.

Among weed management practices, the maximum rhizobium population was observed under untreated control and it was at par with post-emergence application of (imazethapyr 35% + imazamox 35%) 100 g ha^{-1} and pre-emergence application of (pendimethalin 30% EC + imazethapyr 2%) 1.0 kg ha^{-1} at all intervals during both the years as well as on mean data basis. The minimum rhizobium population was under pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1} at 20 DAS and imazethapyr 50 g ha^{-1} as PE fb metribuzin 0.3 kg ha^{-1} as PoE.

The interaction between nutrient and weed management practices was found non- significant on rhizobium population.

Yield attributes and yield of chickpea

Number of pods plant^{-1}

The data pertaining to number of pods plant^{-1}of chickpea are presented in Table2. There was significant influence on number of pods plant^{-1}due to nutrient management. The maximum number of pods per plant was observed in 125% RDF(34.52 and 38.62 during 2013-14 and 2014-15, respectively with mean 36.57), which was at par with 100% RDF (33.14 and 38.19 during 2013-14 and 2014-15, respectively with mean 35.69).

Weed management practices exerted significant impact on number of pods plant^{-1}. Pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1}produced significantly higher number of pods plant^{-1}(39.56 and 42.56 during 2013-14 and 2014-15, respectively with mean of 41.06) than rest of weed management practices. The minimum number of pods plant^{-1} was recorded under imazethapyr 50 g ha^{-1} as PE fb metribuzin 0.3 kg ha^{-1} as PoE *i.e.* 20.78 and 24.56 during 2013-14 and 2014-15, respectively with mean of 23.17.

The interaction between nutrient and weed management practices on number of pods plant^{-1}was significant.

Number of seeds pod^{-1}

The data pertaining to number of seeds pods $^{-1}$of chickpea are presented in Table 2. There was no significant influence on number of seeds pods $^{-1}$due to nutrient management, weed management practices as well as interaction between nutrient management and weeds management practices.

100 seed weight (g)

The data in respect to 100 seed weight of chickpea as influenced by nutrient and weed management are presented in Table2.

There was significant influence on test weight of chickpea due to nutrient management. 125% RDF showed test weight of 13.81 and 14.06 g during 2013-14 and 2014-15, respectively with mean of 13.94 g.

Weed management practices exerted significant impact on 100 seed weight. 100 seed weight was significantly higher under pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1}(14.29 and 14.51 g during 2013-14 and 2014-15, respectively with mean 14.40 g) than rest of treatments. The lowest 100 seed weight was under imazethapyr 50 g ha^{-1} as PE fb metribuzin 0.3 kg ha^{-1} as PoE(11.34 and 12.00 g during 2013-14 and 2014-15, respectively with mean of 11.67 g).

Interaction between nutrient and weed management practices was nonsignificant on 100 seed weight.

Seed yield (q ha^{-1})

Table 1 shows that 125% RDF resulted in significantly higher seed yield of 15.30 q ha^{-1} and 17.89 q ha^{-1} during 2013-14 and 2014-15, respectively with mean of 16.60 q ha^{-1} compared to other nutrient management practices. The lowest seed yield was under 150% RDF *i.e.* 13.49 and 15.85 q ha^{-1} during 2013-14 and 2014-15, respectively with mean of 14.67 q ha^{-1}.

This may be due to fact that more amount of nutrients significantly reduced grain yield as a result of excessive vegetative growth at the expense of pod formation.

Weed management practices exerted significant impact on seed yield of chickpea. The highest seed yield of 19.56 and 21.76 q ha^{-1} during 2013-14 and 2014-15, respectively with mean of 20.66 q ha^{-1} was under Metribuzin 0.4 kg/ha + Oxyfluorfen 0.3 kg/ha as PE. The lowest seed yield was under Imazethapyr 50 g/ha as PE fb Metribuzin 0.3 kg/ha as PoE *i.e.* 7.01 and 8.41 q ha^{-1} during 2013-14 and 2014-15, respectively with mean of 7.71 q ha^{-1}.

The interaction effect of nutrient management and weed management practices was significant on seed yield.

Stover yield

Stover yield of chickpea was significantly influenced with nutrient management. Highest stover yield was obtained with 150% RDF *i.e.* 18.24 and 21.15 q ha^{-1} during 2013-14 and 2014-15, respectively with mean of 19.70 q ha^{-1}(Table 1). The lowest stover yield of 16.36 and 19.52 q ha^{-1} during 2013-14 and 2014-15, respectively with mean of 17.94 q ha^{-1} was under 100% RDF. Higher yield was due to higher dry accumulation of plant.

Weed management practices exerted significant impact on stover yield of chickpea. The highest stover yield of 21.04 and 23.77 q ha^{-1} during 2013-14 and 2014-15, respectively with mean of 22.41 q ha^{-1} was under Metribuzin 0.4 kg/ha + Oxyfluorfen 0.3 kg/ha as PE. The lowest stover yield of 11.70 and 14.52 q ha^{-1} during 2013-14 and 2014-15, respectively with mean of 13.11 q ha^{-1} was under Imazethapyr 50 g/ha as PE fb Metribuzin 0.3 kg/ha as PoE.

Higher seed and stover yield under above treatments was due to the weed managed at critical period and early crop growth, higher dry matter production, high growth and ultimately high yield. Lower weed population and higher weed control efficiency also resulted in higher seed and stover yield.

The interaction effect of nutrient management and weed management practices was non-significant on stover yield.

Discussion

The maximum number of pods and higher seed yield under 125% RDF was due to fact that more amount of nutrients under 150% RDF significantly reduced grain yield and increased stover yield as a result of excessive vegetative growth at the expense of pod formation. The maximum number of pods and seed yield under pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1} was due to the less competition at critical periods of crop growth and better suppression of weeds, which allowed the crop to grow their potential by absorbing sufficient nutrients, light, moisture and space which facilitate more translocation of photosynthates towards the reproductive parts as well as presence of favourable agro-climatic conditions due to removal of weeds, led to more number of pods plant^{-1}. Lower weed population and higher weed control efficiency also resulted in higher seed yield. Contrarily, the poor growth of plants as well as development of yield attributing characters under imazethapyr 50 g ha^{-1} as PE fb metribuzin 0.3 kg ha^{-1} as PoEwas due to phytotoxic effect of metribuzin which resulted in lower seed yield. The higher stover yield under pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1} and oxyfluorfen 0.3 kg ha^{-1} as PE fb imazethapyr 50 g ha^{-1} as PoE was due to lesser weeds during early crop growth period and get higher yield attributes and pod yield which leads to higher stover yield. While, under imazethapyr 50 g ha^{-1} as PE fb metribuzin 0.3 kg ha^{-1} as PoE, the lowest stover yield was due to phytotoxic effect of metribuzin.

Economics

The data on economics of chickpea are presented in Table 3. Application of 125% RDF gave the maximum gross returns (₹66076ha^{-1} and ₹82594ha^{-1} during 2013-14 and 2014-15, respectively with mean of ₹74335ha^{-1}), net returns (₹44282ha^{-1} and ₹58688 ha^{-1}during 2013-14 and 2014-15, respectively with mean of ₹51485ha^{-1}) and benefit: cost ratio (3.03 and 3.45 during 2013-14 and 2014-15, respectively with mean of 3.24). In variance, the minimum with gross returns (₹ 58466ha^{-1} and ₹73431ha^{-1} during 2013-14 and 2014-15, respectively with mean of ₹65949ha^{-1}), net returns (₹ 36429ha^{-1} and ₹49282 ha^{-1}during 2013-14 and 2014-15, respectively with mean of ₹42856ha^{-1}) and benefit: cost ratio (2.65 and 3.04 during 2013-14 and 2014-15, respectively with mean of 2.85) was observed under 150% RDF.

Amongst the weed management practices, pre-emergence application of metribuzin 0.4 kg ha^{-1}+ oxyfluorfen 0.3 kg ha^{-1}gave the maximum gross returns (₹ 84251 ha^{-1} and ₹ 100317 ha^{-1} during 2013-14 and 2014-15, respectively with mean of ₹ 92284 ha^{-1}), net returns (₹ 61176 ha^{-1} and ₹ 75130 ha^{-1} during 2013-14 and 2014-15, respectively with mean of ₹ 68153 ha^{-1}) and benefit: cost ratio (3.65and 3.98 during 2013-14 and 2014-15, respectively with mean of 3.82).. Application of imazethapyr 50 g ha^{-1} as PE fb metribuzin 0.3 kg ha^{-1} as PoE obtained minimum gross returns (₹31459.89 ha^{-1} and ₹ 39287.22 ha^{-1} during 2013-14 and 2014-15, respectively with mean of ₹35373.56 ha^{-1}), net returns (₹7523.59 ha^{-1} and ₹13238.92 ha^{-1}during 2013-14 and 2014-15, respectively with mean of ₹1038.26 ha^{-1}) and benefit: cost ratio (1.31 and 1.51 during 2013-14 and 2014-15, respectively with mean of 1.41).

Discussion

The maximum gross return, net return and B: C ratio obtained under 125% RDF and pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1}was because of higher seed yield associated with lower cost of cultivation.

Energetics

The data related to energetics of chickpea are presented in Table 3.

The maximum net energy output (37805 MJ ha^{-1} and 45225 MJ ha^{-1} during 2013-14 and 2014-15, respectively with mean of 41515 MJ ha^{-1}),energy intensiveness (2.07 and 2.20 during 2013-14 and 2014-15, respectively with mean of 2.13) was under application of 125% RDF. Whereas, energy output: input ratio (5.22 and 6.29 during 2013-14 and 2014-15, respectively with mean of 5.76) was under application of 100% RDF to chickpea.

Amongst the weed management practices, the maximum net energy output (49947 MJ ha^{-1} and 56606 MJ ha^{-1}, during 2013-14 and 2014-15, respectively with mean of 53276 MJ ha^{-1}),energy output: input ratio (9.78 and 11.09 during 2013-14 and 2014-15, respectively with mean of 10.43), energy intensiveness (2.39 and 2.45 during 2013-14 and 2014-15, respectively with mean of 2.42)was under pre-emergence application of metribuzin 0.4 kg ha^{-1} + oxyfluorfen 0.3 kg ha^{-1}.

Minimum energy output: input ratio, energy intensiveness, net energy output was under imazethapyr 50 g ha^{-1} as PE fb metribuzin 0.3 kg ha^{-1} as PoE.

Table 1: Performance of nutrient and weed management on crop stand, plant height, nodulation and rhizobium population of chickpea

Treatments	Crop stand (per m row)			Plant height (cm)						Nodules (no. pt^{-1})			Nodule dry weight (mg $plant^{-1}$)			Rhizobium population (x 10^6 g^{-1} soil)		
				45DAS			Harvest			45 DAS			45 DAS			45 DAS		
	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean
Nutrient management																		
N1	17.35	18.10	17.73	11.57	13.18	12.38	13.37	14.32	13.85	26.43	28.00	27.22	75.30	77.41	76.36	55.90	57.86	56.88
N2	16.05	16.20	16.13	14.39	15.96	15.18	14.40	16.60	15.50	24.63	24.38	23.36	67.68	73.05	70.37	50.90	52.86	51.88
N3	14.89	15.50	15.20	14.64	16.39	15.52	14.44	17.19	15.82	21.95	22.43	22.19	67.43	70.93	69.18	49.24	50.95	50.10
SEm±	0.44	0.39	0.40	0.22	0.21	0.20	0.19	0.20	0.19	0.47	0.96	0.37	1.01	1.56	1.02	0.66	1.02	0.53
CD (P= 0.05)	1.71	1.53	1.58	0.85	0.82	0.80	0.75	0.80	0.73	1.83	3.78	1.45	3.95	6.14	3.99	2.59	4.02	2.09
CV (%)	12.43	10.77	11.29	7.35	6.31	6.54	6.19	5.79	5.63	9.05	17.70	6.97	6.25	10.21	6.47	5.80	8.70	4.62
Weed management																		
W1	13.63	14.00	13.82	15.45	16.82	16.14	15.30	18.07	16.69	28.67	32.11	30.39	77.41	85.33	81.37	49.89	51.89	50.89
W2	17.79	18.32	18.06	11.94	14.42	13.18	16.22	18.41	17.32	22.67	23.44	23.06	71.33	72.54	71.94	56.56	59.56	58.06
W3	15.93	16.30	16.12	13.78	15.26	14.52	14.69	17.09	15.89	25.44	25.44	25.44	72.98	78.77	75.38	55.67	57.56	56.62
W4	14.51	15.22	14.87	14.37	15.96	15.17	14.91	17.63	16.27	26.77	28.78	28.00	74.97	80.62	77.80	54.56	56.67	55.62
W5	15.44	15.93	15.69	15.07	16.57	15.82	17.10	18.73	17.92	28.33	29.89	29.11	75.34	83.23	79.29	52.22	52.33	52.28
W6	16.89	17.63	17.26	12.86	14.43	13.65	7.01	9.71	8.36	12.44	14.67	13.56	49.81	47.44	48.63	36.11	39.22	37.67
W7	18.48	18.81	18.65	11.26	12.79	12.03	13.27	14.61	13.94	20.22	20.22	20.22	69.14	69.63	69.39	57.11	62.00	59.56
SEm±	0.42	0.39	0.39	0.36	0.37	0.35	0.45	0.34	0.27	0.62	1.00	0.53	1.84	2.31	1.50	1.41	1.77	1.03
CD (P= 0.05)	1.22	1.12	1.12	1.03	1.05	1.02	1.30	0.97	0.77	1.79	2.87	1.51	5.27	6.62	4.30	4.04	5.07	2.95
CV (%)	7.92	7.05	7.19	7.93	7.25	7.41	9.67	6.31	5.34	7.95	12.05	6.52	7.47	9.87	6.25	8.12	9.84	5.83
I X W	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

N1-Recommended dose of fertilizers (20 kg N, 50 kg P_2O_5 and 30 kg K_2O ha^{-1}), N2- 125% RDF (25 kg N, 62.5 kg P_2O_5 and 37.5 kg K_2O ha^{-1}), N3-150 % RDF (30 kg N, 75 kg P_2O_5 and 45 kg K_2O ha^{-1})
W1-Metribuzin 0.4 kg ha^{-1} + Oxyfluorfen 0.3 kg ha^{-1} as PE, W2-(Imazethapyr 35% + Imazamox 35%) 100 g ha^{-1} as PoE, W3-(Pendimethalin 30 % EC + Imazethapyr 2%) 1.0 kg ha^{-1} as PE, W4-Sulfentrazone 300 g ha^{-1} as PE, W5-Oxyfluorfen 0.3 kg ha^{-1} as PE fb Imazethapyr 50 g ha^{-1} as PoE, W6-Imazethapyr 50 g ha^{-1} as PE fb Metribuzin 0.3 kg ha^{-1} as PoE, W7-Untreated control

Table 2: Performance of nutrient and weed management on yield attributes and yield of chickpea

Treatments	No. of pods $plant^{-1}$			No. of seeds pod^{-1}			100 seed weight (g)			Seed yield (q ha^{-1})			Stover yield (q ha^{-1})		
	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean
Nutrient management															
N1	33.14	38.19	35.69	2.00	2.00	2.00	13.19	13.51	13.34	14.88	17.13	16.01	16.36	19.52	17.94
N2	34.52	38.62	36.57	2.00	2.00	2.00	13.81	14.06	13.94	15.30	17.89	16.60	18.08	20.98	19.53
N3	31.14	34.76	33.17	1.95	1.95	1.95	12.97	13.24	13.11	13.49	15.85	14.67	18.24	21.15	19.70
SEm±	0.47	0.60	0.24	0.03	0.03	0.03	0.16	0.14	0.15	0.32	0.34	0.31	0.33	0.29	0.31
CD (P= 0.05)	1.84	2.34	0.95	NS	NS	NS	0.62	0.55	0.59	1.25	1.33	1.22	1.30	1.15	1.23
CV (%)	6.50	7.35	3.16	-	-	-	5.43	4.75	5.08	10.03	9.14	9.02	8.63	6.55	7.51
Weed management															
W1	39.56	42.56	41.06	2.00	2.00	2.00	14.29	14.51	14.40	19.56	21.76	20.66	21.04	23.77	22.41
W2	33.00	37.56	35.28	2.00	2.00	2.00	13.31	13.45	13.38	12.97	15.74	14.36	15.83	19.45	17.64
W3	33.78	38.44	36.11	2.00	2.00	2.00	13.45	13.70	13.58	15.75	17.98	16.87	18.76	21.62	20.19
W4	35.11	39.22	37.22	2.00	2.00	2.00	13.86	14.12	13.99	16.63	19.18	17.91	19.72	22.55	21.14
W5	36.87	41.33	39.00	2.00	2.00	2.00	14.13	14.43	14.28	17.47	20.58	19.03	20.09	22.92	21.51
W6	20.78	24.56	23.17	1.89	1.89	1.89	11.34	12.00	11.67	5.01	6.41	5.71	9.70	12.52	11.11

W7	31.67	36.67	34.17	2.00	2.00	2.00	12.83	13.01	12.92	12.51	15.04	13.78	15.78	19.01	17.40
SEm±	0.96	0.76	0.71	0.04	0.04	0.04	0.22	0.21	0.21	0.42	0.34	0.33	0.43	0.37	0.39
CD (P= 0.05)	2.76	2.19	2.03	NS	NS	NS	0.64	0.60	0.60	1.20	0.97	0.94	1.24	1.07	1.11
CV (%)	8.77	6.15	6.06	-	-	-	4.99	4.59	4.66	8.62	6.01	6.24	7.38	5.46	6.09
I X W	S	S	S	NS	NS	NS	NS	NS	NS	S	S	S	NS	NS	NS

Table 3: Performance of nutrient and weed management on economics and energetics of chickpea

Treatments	**Net returns (Rs ha^{-1})**			**B:C ratio**			**Net energy output (MJ ha^{-1})**			**Energy output: input**			**Energy intensiveness (MJ Re^{-1})**		
	2013-14	**2014-15**	**Mean**	**2013-14**	**2014-15**	**Mean**	**2013-14**	**2014-15**	**Mean**	**2013-14**	**2014-15**	**Mean**	**2013-14**	**2014-15**	**Mean**
Nutrient management															
N1	42583	55379	48981	2.98	3.34	3.16	35517	42781	39149	5.22	6.29	5.76	1.96	2.10	2.03
N2	44282	58688	51485	3.03	3.45	3.24	37805	45225	41515	5.18	6.20	5.69	2.07	2.20	2.13
N3	36429	49282	42856	2.65	3.04	2.85	34836	41945	38390	4.47	5.39	4.93	1.93	2.06	2.00
Weed management															
W1	61176	75130	68153	3.65	3.98	3.82	49947	56606	53276	9.78	11.09	10.43	2.39	2.45	2.42
W2	33296	47379	40338	2.43	2.87	2.65	33861	42455	38158	6.79	8.51	7.65	1.67	1.87	1.77
W3	44358	57585	50972	2.90	3.26	3.08	41492	48349	44921	8.13	9.47	8.80	1.99	2.10	2.05
W4	50227	64948	57587	3.34	3.75	3.55	44114	51392	47753	8.85	10.31	9.58	2.28	2.39	2.34
W5	52410	69874	61142	3.29	3.79	3.54	45649	53769	49709	8.89	10.47	9.68	2.21	2.35	2.28
W6	7524	13239	10381	1.31	1.51	1.41	19796	25375	22585	3.85	4.94	4.40	1.04	1.17	1.11
W7	33132	46905	40019	2.61	3.07	2.84	33278	41043	37160	6.88	8.49	7.69	1.85	2.02	1.94

Figures rounded up to nearest value

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