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Studies on the Effect of Weed Control Methods and Mulches on Growth and Yield of Late Variety of Chickpea (*Cicer arietinum* L.)

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ABSTRACT

Background: Chickpea is poor competitor to weeds because of slow growth rate and limited leaf development at early stage of crop growth and establishment especially in autumn season. Weed population and biomass in autumn chickpea are seven and two and half times higher than spring season of chickpea respectively. Mulching has a crucial role in weed suppression and moisture conservation in rain-fed condition where the trial was laid out.

Methods: A field experiment was conducted during 2019-20 to study the effect of different weed control methods and mulching on growth and yield of chickpea at Brahmanand Post Graduate College, Rath district Hamirpur. Uttar Pradesh. Dry biomass at full growth stage was found maximum (18.14 g plant^{-1}) in combination with alachlor pre-emergence application @1.0 litre ha^{-1} and saw dust @ 5.0 tonne per hectare.

Result: Plant height and tertiary branches were counted maximum with the same method of weed control and mulching. Highest seed (49.32 q ha^{-1}) was also calculated with the application of alachlor weedicide which was found superior over pendimethaline and mechanical weed control. Sawdust mulching application also produced maximum seed yield (48.73 q ha^{-1}) followed by straw and grass mulching.

Key words: Growth, Moisture conservation, Mulching, Weed control, Yield attributes, Yield of late chickpea.

INTRODUCTION

In Uttar Pradesh, chickpea is cultivated in an area of 0.62 million hectares with a production and productivity of 0.51 million tonnes and 824 kg/ha, respectively. Weed infestation in chickpea offer serious competition and cause yield reduction to the extent of 75%. The initial 60 days period is considered to be the critical for weed crop competition in chickpea. With the increase in labour cost and scarcity of labour, manual weed control has become a difficult task. Suitable herbicide for effective control of mixed weed flora is required for better adoption in this crop by farmers. Pulses historically have been one of the most important constituent of the Indian cropping and consumption patterns and long considered “the poor man’s meat” as it is one of the less expensive sources of protein (Mohanty and Satyasai, 2015). Among pulses, chick pea (*Cicer arietinum*) is preferred to food legumes because of its multiple uses for growing population across the world. During 2017-18, globally it was grown on 149.66 lakh ha area, with the total production of 162.25 lakh tonnes (FAOSTAT, 2019) and average productivity of 1252 kg/ha. Out of which, 71 per cent of global area with 70 per cent of global production of *chick pea* is contributed by India as it ranks 1st in area and production but lags behind several countries in terms of productivity because of poor adoption of improved varieties and production technologies by farmers’. Apart from India, Australia (12.35%), Myanmar (3.25%) and Ethiopia (2.92%) are the major chick pea producing countries of the world. The chick pea production in India has gone up from 38.55 to 112.29 lakh tonnes during 2000-01 to 2017-18, while the area has also gone up from 51.85 to 105.61 lakh ha, whereas, the yield has steadily increased from 744 kg/ha to 1063 kg/ha during the same period. Madhya Pradesh is leading state in terms of area and production as it contributes around 34 and 40 per cent share to the total area and production of gram in the country. Madhya Pradesh stood first among all the states in both area (3.59 m ha) and production (4.60 MT) of chickpea but productivity (1280 kg ha^{-1}) is far below its yield potential, chickpea is grown under rainfed as well as irrigated condition in India. But weed in irrigated areas tend to offer severe competition for growth resources and cause drastic yield reduction to the extent of 75% in chickpea.

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The most predominating weed in chickpea affecting its productivity drastically in India are *Chenopodium album*, *Medicago truncatula*, *Melilotus alba*, *Portulaca oleraceae*, *Anagalis arvensis* and *Amaranthus viridis*. One of the most serious but less noticeable is the weed in infestation which reduce its productivity to a great extent. Chickpea are poor competitors with weeds because of their slow emergence and growth during winter. Weeds affect growth, yield and quality of crop plants adversely and reduce soil fertility, compete with the crop plants for soil moisture. Nutrients, space and sunlight, effective weed control is essential for good yields and to avoid build up of trouble some weeds in the rotation. Organic mulch includes sawdust, grass mulching and straw mulch. Investigation significant increase in crop yield of mulching resulted in better grain yield and water use efficiency in different chickpea cultivars (Regar *et al.*, 2010 and Yadav *et al*., 2017).

Some varieties are mulch tolerant while some are susceptible to weed infestation. Like wish in several cases of chemical weed control method, herbicides residues have negatively affected the yield components and nodulation of susceptible varieties of chickpea. While the judicious use of herbicides avoided yield losses caused by weeds and raised the yield of many crops including chickpea. In light of important of chickpea and its yield losses owing to weeds infestation, a field experiment entitled "Studies on the effect of weed control methods and mulches on growth and yield of late variety of chickpea (*Cicer arietinum* L.)" during autumn season of 2019-20 at the research farm of Brahmanand Post Graduate College, Rath (Hamirpur) U.P. affiliated to Bundelkhand University, Jhansi, UP was conducted.

MATERIALS AND METHODS

The field experiment was conducted at Research Farm of Brahmanand Post Graduate College, Rath (Hamirpur) U.P. affiliated to Bundelkhand University, Jhansi, UP during winter season of 2019-20 in the subtropical zone at latitude and longitudinal range of 79.7° East and 25.5° North. It is located at an elevation range of 526 feet's from the mean sea level. The annual rainfall ranges between 875-975 mm, which is received mostly from last week of June to last of September with occasional shower in winter. The soil of the experimental field was Parwa in texture having soil pH 7.6, organic carbon 0.53%, field capacity 17.33%, permanent wilting point 6.8% and bulk density 1.48 gm/cm^3 respectively. The available nitrogen, phosphorous and potassium were 108.8, 24.55 and 123.0 kg per ha^{-1}, respectively. Sixteen combinations of four weed control methods *i.e.* control, mechanical weeding, pendimethaline @ 1.25 litre ha^{-1} and alachlor @ 1.0 litre ha^{-1} and four mulching methods *i.e.* control, saw dust, grass mulch and straw mulch were used for the experiment.

Sowing of seeds of chickpea variety Pusa-256 was undertaken in the field at crop spacing of 30 cm × 10 cm. on 25th October 2019. The fertilizer dose of N, P_2O_5 and K_2O was applied at rate of 20:40:20 kg ha^{-1}. Observation dry biomass plant^{-1} (g), plant height at 90 DAS and tertiary branches plant^{-1}, number of nodules plant^{-1}, No of pod plant^{-1}, weight of pods plant^{-1} and number of seeds plant^{-1} and seed yield (q ha^{-1}) were recorded. The data collected from the experiment was analysed statistically using the analysis of variance procedure, appropriate for the factorial randomized block design. The test of significance was carried out at 5 per cent level.

RESULTS AND DISCUSSION

Effect on growth characters

Source of weed control was significantly affected the dry matter accumulation, plant height (cm) and tertiary branches per plant (g). Data given in Table 1 shows that dry weight per plant was found maximum (18.14 g plant^{-1}) with application of alachlor weedicide which was non-significantly more than application of pendimethalin application, both the chemical methods of weed control were significantly superior over mechanical weed control and control measure. The chemical weeding plays a very important role in controlling weeds. weedicide inhibits oxidative phosphorylation which ultimately obstructed several metabolic reactions of weeds. It also played a great role for improper root and shoot development of weed during growth stages. The minimum dry biomass (15.05 g plant^{-1}) was found with control where weeds were allowed free to grow with the trial. The highest and lowest value was differed 20.53% which was due to prominent role of weedicide in controlling of weeds and inhibiting loss of soil moisture and nutrients by weeds and using properly sun light by the crop, the similar investigation was done by Saxena *et al.* (1976), Singh *et al.* (1980). Similar trend was observed in plant height (cm) and tertiary branches at 90 DAS, the maximum value was recorded with the application of alachlor weedicide, plant height (44.17) and tertiary branches per plant (5.69) were found superior over others weed control methods *viz.* pendimethalin weedicide, mechanical control and control measure. Pendimethalin weedicide decreased the number of branches non-significantly when compared with alachlore weedicide application while these branches were counted significantly more over mechanical weed control and control measure. Reduction in weed biomass and increased weed control efficiency under pre-emergence application of alachlor was due to complete removal of weeds at critical period of crop weed competition. The results are in consonance with Singh and Panday (2004).

Growth characters *viz.* dry weight plant^{-1}(19.26 g), plant height (43.21) and tertiary branches (5.53) per plant were recorded significantly maximum to sawdust mulch application followed by grass mulching, straw mulching and control measure. Although all mulches plays a very important role in reducing evaporation increase water holding capacity of the soil and weed control due to which the germination of seeds have highly increase which play

Table 1: Growth parameters and yield attributesinfluenced by weed control methods and mulching source.

Treatment	Dry weight plant^{-1} at 90 DAS	Plant height (cm) at harvest	Number of primary branches plant^{-1} at 90 DAS	Number of secondary branches plant^{-1} at 90 DAS	Number of tertiary branches plant^{-1} at 90 DAS	Number of nodules plant^{-1} at 90 DAS	Number of pods plant^{-1}	Weight of pods plant^{-1} (g)	Number of seeds pod^{-1}	Seed yield (qha^{-1})	B:C ratio
Weed control											
Control	15.05	35.12	1.09	09.17	4.31	20.01	24.10	5.64	1.26	37.62	1.10
Mechanical weeding	16.36	39.44	1.46	10.76	5.08	28.73	32.11	7.35	1.32	45.96	1.44
Pendimethalin	17.61	42.22	1.48	11.33	5.35	25.70	32.96	7.68	1.30	47.19	1.52
Alochlor	18.14	44.17	1.62	12.05	5.69	32.08	34.93	8.08	1.35	49.32	1.65
S.E. (d) ±	0.33	0.35	0.06	0.28	0.16	0.05	.039	0.10	0.05	0.91	
C.D. at 5%	0.69	0.80	0.14	0.56	0.33	2.11	0.81	0.20	N.S.	1.87	
Mulching materials											
Control	15.44	36.23	1.31	9.99	4.12	20.89	28.41	6.57	1.28	42.29	1.15
Sawdust	19.26	43.21	1.63	11.70	5.53	32.56	33.06	7.48	1.35	48.73	1.55
Grass mulch	16.57	39.12	1.39	10.51	4.23	26.16	30.95	7.28	1.24	44.40	1.35
Straw mulch	16.70	40.12	1.40	10.70	4.33	28.21	31.68	7.41	1.29	47.91	1.45
S.E. (d) ±	0.33	0.35	0.06	0.28	0.16	0.05	0.39	0.10	0.05	0.91	
C.D. at 5%	0.69	0.80	0.14	0.56	0.33	2.05	0.81	0.20	N.S.	1.87	

a big role in plant establishment as well as increasing all growth characters of plants, however improved growth characters in saw dust might be due to optimum availability of nutrients and moisture. Grass mulching and straw mulching did not differ significantly in this regard but both of these mulching were increased significantly over control measure. The similar results were given Mahajan *et al.* (2007).

Nodule in chickpea plays prominent roles in nourishing of plant in their entire growth stage. Observations recorded on the nodule number of chickpea, generally found to vary at 90 DAS of the crop growth. Among the treatments, more number of nodules was noticed in the plots where herbicides were not imposed (mechanical control) when compared with different pre emergence herbicides imposed plots *i.e.* alachlor and pendimethalin. Observations of nodule number at 90 days after sowing ranged from 20 to 32 per plant and noticed highest in mechanical control (32.08 plant^{-1}). Whereas, the lowest nodules per plant were noticed in control measure (20.01). Among the pre emergence herbicides, significantly higher nodules was observed in mechanicalcontrol (32.08 plant^{-1}) and significantly the lowest nodules was found in pendimethalin weedicide application (25.70 plant^{-1}) may be due to proper utilization of nutrients and sunlight by the crop in absence of weed plants. Similar results were recorded by Bhalla *et al.* (2001). Number of nodules per plant were significantly increased with sawdust mulch application (32.56) which was found 4.35, 6.40 and 11.67 more over straw mulching, grass mulching and control, respectively. The grass mulching and straw mulching were found at par regarding number of nodules per plant and could not differ significantly among each other. Significantly lowest number of nodules per plant (20.89) were counted with control plot due to huge completion between crop and weed plants for nutrients and water consumption at initial growth stage consequently the nodules could not flourished properly in control plot, Raghvendra and Gundappagol (2017).

Effect on yield attributes and yield

Table 1 indicated that number of pods plant^{-1}, weight of pods plant^{-1} (g) and number of seeds plant^{-1} were recorded significantly maximum with alachlor weedicide application followed by Pandimathlin application, mechanical control and the check plot. It was also noted that each treatments *viz*. Alachlor, Pendimethalin and control were differed significantly among each other. Higher value of number of pods plant^{-1} (34.93) was recorded with application of alachlor weedicide which was significantly more over pendimethalin, mechanical control and the check plot, respectively, the minimum value was found with control measure (24.10). Similarly, significantly highest weight of pods plant^{-1} (8.08 g) was recorded with alachlor weedicide application. Highest number of seeds per pod (1.35) was counted with alachlor weedicide application which was non significantly more over other control measures. Pendimethalin was significantly increased over mechanical control measure and the mechanical measure was superior over the check plot. The yield attributes were increased due to proper growth of plant by using mechanical as well as chemical methods of weed control. The results were close conformity with Kolar *et al.* (1989). Seed yield maximum (49.32 q ha^{-1}) was calculated with alachor weedicide application which was 4.51%, 7.31% and 31.10% more over pendimethalin, mechanical weed control and the check plot. The alachlor weedicide application was significantly increased over pendimethalin and mechanical control as well as both these weed control measures were significantly increased over control measure.

In general, the mulches had higher water saving efficiency over general cultivation and conserves water to the root zone with alower loss of moisture by evapotranspiration. Maintenance of ideal moisture with sawdust mulch, resulted in better yield and yield attributes. Significantly higher number of pods perplant were recorded in sawdust mulch with (33.06) followed by straw mulch (31.68), grass mulch (30.95) and lowest podsper plant were recorded in control plot (28.41). Similarly, higher weight of pods plant^{-1} (7.48 g) was recorded with sawdust mulch application which was significantly more over other methods of mulchs application *viz.* straw, grass and control measure. Lowest value for weight of pods plant^{-1} were recorded with grass mulching (7.28) however it was significantly more over the control plot (6.57). The increasing yield attributing characters were due to itself increased growth parameters observed during the crop growth period. The higher seed yield under mulch treatmentsmay also be attributed to reduced nutrient losses due to weedcontrol and improved hydrothermal regimes of soil (Rajak and Prasad, 2017), highest seed yield (48.73 q ha^{-1}) was calculated with sawdust mulch application which was increased 0.82 q ha^{-1}, 4.33 q ha^{-1} and 6.44 q ha^{-1} more yield over straw mulch, grass mulch and the control check. The increased yield of chickpea under mulching conditions could be due to higher chlorophyll content with enhanced photosynthetic activity and higheruptake of nutrients. This could have helped inincreased plant dry matter production at pod setting phase, resulting in more number of pods per plant and finallycontributed for higher productivity. These observations werein conformity with the findings of Rao *et al.* (2019) in other legumes crop.

Meteorological observations

Weather observation data given in Table 2 indicated that chickpea is sensitive to light and temperatures and it requires long days and cool temperatures. Average around 20°C with warm days (20°-25°C) and cool (5°-10°C) and chickpea uses 100 to 450 mm of water.

During the year (2019-20) the total rainfall was above normal and during cropping period, the rainfall from September to February was as high as 16.00 mm which was much lower fromnormal of 125.50 mm. However proper irrigation facilities were available at research farm and the crop was irrigated as per schedule. During the

Table 2: Meteorological study.

Standard meteorological week		40	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13
Tempe-	Max	35.8	34.6	34.8	33.6	32.1	29.4	3.9	3.2	26.5	25.7	22.9	22.8	21.9	23.6	21.2	22.9	21.4	21.5	22	23.5	27.3	23.3	26.4	28	32.2	35.6
-rature (°C)	Min	20	18.3	15.9	14.9	14.5	11.1	11.9	11.4	9.8	8.1	7.0	4.8	4.8	5.8	5.1	4.8	8.2	5.9	7.7	9.5	11	9.4	11.7	12.3	14.1	16.4
Relative	I	80	79	76	75	78	79	83	81	81	78	87	90	91	88	88	90	90	89	89	90	83	89	82	80	75	63
Humidity	II	36	36	36	38	43	47	46	44	44	43	46	49	56	48	52	45	55	58	57	45	47	52	44	43	38	33
(%)																											
Rainfall (mm)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.4	0.4	0	3.2	0	0	0	0
Evaporation (mm)		5.3	5.3	5.3	5.1	4.4	4.4	3.9	3.6	3.6	3.3	0.7	2.7	2.3	2.6	2.4	2.5	2.4	2.5	2.7	2.8	3.8	4	4.4	5	6	7.6

40th Weed- 1st Oct to 7th Oct, 2019 13th week- 25th March to 1st April, 2020.

crop growth period in 2019-20 the lowest and highest mean temperature recorded 5.1°C and 35.6°C but during the peak growth stage of crop it was not exceeded beyond 28°C which is quite favourable for chickpea growth. Relative humidity is one of the most important constraints for chickpea growth which must be in the range of 80-90 per cent. Highest humidity was recorded in the month of January and February 2020 which was in the range of 88-90 and it is most favourable humidity for the chickpea growth. Similar findings were presented by Patil and Halikatti (2013).

CONCLUSION

The present investigations were carried out with a purpose to assess the adoption of weed control measure and water and nutrients saving by applying mulching material inchickpea crop in terms of technical feasibility and yield. The findings of the study are encouraging to adopt alachlor weedicide along with sawdust mulching in thiscrop for obtaining higher seed yield.

Conflict of interest

All authors declare that they have no conflict of interest.

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