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ECO-FRIENDLY WEED CONTROL APPROACHES IN ORGANIC CHICKPEA (*CICER ARIETINUM*) CULTIVATION

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ABSTRACT

A field experiment was conducted at Agronomy Instructional Farm, C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* 2024-2025 entitled "Weed management practices in chickpea (*Cicer arietinum* L.) under organic farming" on loamy sand soil. The experiment was conducted in Randomized Block Design with three replications and eight treatments. The chickpea variety GG 5 was sown at a distance of 45 cm between the rows and 10 cm plant to plant spacing. Among different treatments, weed free recorded significantly higher seed and stover yield (2573 and 4069 kg/ha, respectively). Next to weed free, significantly higher seed and stover yields were observed in hand weeding at 20 and 40 DAS (2377 and 3815 kg/ha, respectively) and was found at par with hand weeding at 20 DAS + IC at 40 DAS (2305 and 3691 kg/ha, respectively), mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS (2223 and 3622 kg/ha, respectively) and sunn hemp straw mulch @7.5 t/ha *fb* HW at 30 DAS (2166 and 3559 kg/ha, respectively) due to effective control of broad leaves, grasses, sedges, and total weeds at 25 DAS, 50 DAS and at harvest with higher weed control efficiency and lower weed index values.
Keywords **:** organic farming, chickpea, weed control efficiency, weed index.

Introduction

Chickpea is an important *rabi* crop mainly sown in September-November and harvested in February-April. Crop duration is 90-120 days, depending on the variety. Desi varieties are short duration while kabuli varieties take relatively longer period to mature. Similarly, cooler like northern India take longer period, compared to relatively warm weather in southern parts of India. It is best suited to areas having low to moderate rainfall and a mid-cold weather. Excessive rains soon after sowing or at flowering stage are harmful for the crop. Severe cold is injurious and is very harmful. It is best suited to areas having moderate rainfall of 600-900 mm per annum. It has an indeterminate growth habit, which means that the growth cycle extends as long as moisture is available (Maurya and Kumar, 2018).

Chickpea is an important food legume commodity and have a diverse use with specific consumer preference in the global market. During 2023-2024, chickpea production of India was 11.04 million tonnes from an acreage of 9.59 million ha. with a productivity of 1151kg/ha (Anonymous; 2023[a]). In Gujarat, total area of chickpea grown is 6.22 lakh hectares, with an annual production is 10.66 lakh tonnes with productivity of 1714.37 kg/ha (Anonymous; 2023[b]).

Organic weed management focuses on controlling weeds without synthetic herbicides, using methods like crop rotation, mulching, hand weeding, and cover crops. It promotes environmental health by preserving soil quality, water resources and biodiversity, while reducing chemical exposure for both consumers and farm workers. By avoiding chemical inputs, organic practices help maintain soil fertility and reduce the risk of herbicide-resistant weeds. Organic weed management also supports long-term sustainability, increases biodiversity, and meets growing consumer demand for environmentally-friendly products.

Chickpea (*Cicer arietinum* L.) is one of the most widespread crops grown under reduced moisture conditions in India. There are many biotic and abiotic factors affecting yield and quality in chickpea production. These factors include drought, low or high temperatures, nutrient deficiency, weeds, diseases and pests. Weeds are among the most important biotic factors limiting chickpea yield. Nevertheless, one of the most important biotic problems encountered in chickpea cultivation is the presence of weeds (Adıyaman and Kahriman, 2021). Chickpea is grown under rainfed as well as irrigated conditions in India but weeds in irrigated areas tend to offer severe competition for growth resources and cause drastic yield reduction to the extent of 75% in chickpea. The most predominating weeds in chickpea affecting its productivity drastically in India are *Chenopodium album*, *Medicago truncatula, Melilotus alba, Portulaca oleraceae, Digera arvensis, Phasalis minima, Cyperus rotundus, Convolvus arvensis* and *Amaranthus viridis* (Bhutada and Bhale, 2013). In General, weed control in chickpea is done by cultural, mechanical and chemical methods (Chavada *et al*., 2017).

Modern agriculture is productivity oriented and depends mainly on synthetic inputs (herbicides) to manage weeds. However, non-judicious use of these synthetic herbicides could cause environmental, health and herbicides resistance issues. Therefore, a focus has been given since last two decades on the use of plant derived organic substances as alternative to inorganic herbicides for weed control (Arif *et al*., 2015).

In organic farming, cultural and mechanical methods are necessary to break the weed cycle. All organic mulches reduced weed germination. The positive effect of mulches was particularly obvious in the period of intensive germination of weeds. Straw, peat and wood chips had the strongest influence on the decrease of weed germination. However, it is important to make sure that mulches are not infected with weed seeds. Mulch of chopped grass is quick to decompose; therefore, repeated mulching is required to protect the crop from weeds (Jodaugiene *et al*., 2006).

Material and Methods

A field experiment was conducted during *rabi*, 2024-25 at Agronomy Instructional Farm, Department of Agronomy, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Banaskantha (385 506) (North Gujarat Agro-climatic region (AES IV) of Gujarat) at a 24^{o} 19' North latitude and 72^{o} 19' East longitude with an elevation of 154.52 meters above the mean sea level. The experiment was laid out in Randomized block design with eight treatments and three replications. The experimental field was ploughed by tractor drawn cultivator and was followed by harrowing and planking to obtain fine seedbed. The chickpea cultivar "GG 5" was sown manually at a spacing of 45×10 cm^2 at a depth of on 11th November, 2024 with a seed rate of 60 kg/ha. The gross plot size and net plot size of the experiment were 5.0×4.5 m^2 and 3.4 × 3.6 m^2, respectively. The recommended dose of Castor cake @ 400 kg/ha was applied on experimental plot 15 day prior to sowing. It was mix with Metarhizium anisopliae @ 2 kg/ha and applied to plot for protection of crop from insect pest. Foliar application of Material and methods panchagavya @ 3% was done at 30, 45 and 60 DAS using knapsack sprayer during evening hours to ensure optimal efficacy. The seeds of chickpea variety Gujarat Gram 5 were treated with Rhizobium and PSB. All the seeds were inoculated well. Seeds were kept in shade for 30 minutes before sowing. The first irrigation was given immediately after sowing to ensure good and uniform seed germination and remaining five irrigations were given as per requirement of crop.

The data indicated that mean maximum temperature ranged between 24.6 to 37.2 ^{o}C, while mean minimum temperature ranged between 6.3 to 23.8 ^{o}C during the period of experimentation. The mean relative humidity recorded at morning and evening ranged from 59 to 87 and 13 to 57 per cent, respectively. The bright sunshine hours and evaporation ranged between 3.8 to 10.2 hours/day and 3.3 to 7.5 mm/day, respectively during crop period. All over climatological data indicated that the weather conditions were normal and favourable for the satisfactory growth and development of the chickpea crop during *rabi* season of 2024-25. The texture of the soil is loamy sand in nature, alluvial in origin, light brown in colour, well drained, fairly retentive of moisture and low in available nitrogen, while medium in available phosphorus and higher in available potash. It is suitable for a variety of crops of arid and semi-arid origins. The soil samples were collected randomly from different random spots of the experimental plots up to depth of 0-15 cm before sowing of the crop and composite sample was analysed for determining the physical properties as well as chemical parameters of the soil. The soil was low in organic carbon and available nitrogen, medium in available P_2O_5 and available K_2O. The crop was harvested on 8th March, 2025 manually at physiological maturity. At first, the border rows (plants from buffer line) were harvested from each plot and taken out from the experimental area. Randomly selected previously tagged five plants from each net plot were harvested separately for

recording different biometric observations and later on these five plant yields were added to the seed yield of respective net plots. During the crop season weeding was carried out by manual labour as per treatments.

The sedges, grasses, broad leaf weeds were uprooted from 0.25 m^2 (50 cm × 50 cm) area in ring area of plots at 25, 50 DAS and at harvest and were kept in separate packets for sun drying and later they were kept in hot air oven at 60°C for 72 hours till the dry weight reaches constant weight. Later, category wise weed dry weight of sedges, grasses and broad leaf weeds were noted down by weighing in weighing balance and later total weed dry weight of each stage were recorded. Further, the data was multiplied with four to convert the data into g m^{-2}. Since the weed dry weight data does not follow normal distribution, the weed dry weight data were analyzed after subjecting to $\sqrt{x+1}$ transformation as suggested by Gomez and Gomez (1984). All the growth and yield observation of greengram were measured using standard procedures.

Results and Discussion

Effect on weed flora, weed dry weight and weed control efficiency

Weed flora

The different species of weeds observed in chickpea crop at experimental field are given in Table 1. The different weed species observed in experimental field were *Chenopodium album* L., *Amaranthus spinosus* L., *Portulaca oleracea L., Boerhavia diffusa* L., *Digera arvensis* L., *Argemone mexicana* L., *Commelina benghalensis* L. *Euphorbia hirta* L., *Phyllanthus niruri* Hook F. and *Leucus aspera* (wild.) Link. among broad leaves, *Eragrostis pilosa* L. P. Beauv., *Dactyloctenium aegyptium* L., *Digitaria sanguinalis* L., *Asphodelus tenuifolius, Cynodon dactylon* L., among grasses and *Cyperus rotundus* L. among sedges. Among broad leaves *Chenopodium album.,* among the grasses *Asphodelus tenuifolius* and among sedges *Cyperus rotundus* L. was dominant at all stages of crop. Overall, the field was dominated with broad leaves which was followed by grasses and sedges.

Weed dry weight

Dry weight of weeds was significantly influenced by different weed management practices in chickpea at 25, 50 DAS and at harvest. Among the different treatments, at 25 DAS weed free upto harvest treatments showcased the zero weed dry weight with maximum weed control efficiency which can be ascribed to effective weed removal through mechanical and physical control measures. Further, next to weed-free treatment hand weeding at 20 and 40 DAS resulted in notably reduced broad leaves, grasses and total weed dry weight (2.55, 1.77 and 3.27 g m^{-2}, respectively) which was statistically at par with hand weeding at 20 DAS + IC at 40 DAS (2.77, 1.87 and 3.43 g m^{-2}, respectively) and stale seedbed *fb* HW at 30 DAS (3.06, 1.96 and 3.91 g m^{-2}, respectively). Whereas, sedges dry weight recorded lower in hand weeding at 20 DAS + IC at 40 DAS (1.58 g m^{-2}) after weed free treatment which was at par with hand weeding at 20 and 40 DAS (1.73 g m^{-2}) and stale seedbed *fb* HW at 30 DAS (1.96 g m^{-2}). Closely related results were documented by Dixit *et al.* (2015) and Dewangan *et al.* (2016).

At 50 DAS weed free treatment recorded significantly lower dry weight of broad leaves, grasses, sedges and total weeds (1.00, 1.00, 1.00 and 1.00 g m^{-2}, respectively). Subsequent to weed free, significantly lower dry weight of broad leaves, grasses, sedges and total weeds were noticed under hand weeding at 20 and 40 DAS (4.07, 3.54, 2.78 and 5.94 g m^{-2}, respectively) and it was found at par with hand weeding at 20 DAS + IC at 40 DAS (4.33, 3.81, 2.92 and 6.33 g m^{-2}, respectively), mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS (4.73, 3.99, 3.07 and 6.77 g m^{-2}, respectively) and sunnhemp straw mulch @7.5 t/ha *fb* HW at 30 DAS (4.76, 4.11, 3.13 and 6.92 g m^{-2}, respectively). The reduced weed dry weight observed in treatments involving mustard straw mulch @ 7.5 t/ha *fb* HW at 30 DAS and sunnhemp straw mulch @ 7.5 t/ha *fb* HW at 30 DAS can be attributed to the effective suppression of weed emergence. The mulches formed a uniform layer over the soil surface, which reduced light penetration and restricted air movement both are critical for weed seed germination and early growth. This physical barrier hindered the establishment of weeds during the early stages, resulting in significantly lower weed biomass in these treatments. Additionally, hand weeding at 30 DAS further enhanced weed control by removing weeds that emerged through or around the mulch layer. Analogous findings have been reported by Sahu *et al*. (2020).

At harvest among various weed management practices, zero dry weights of broad leaves, grasses, sedges and total weeds were found under weed free treatment due to zero weed density at harvest. Except weed free, significantly lower dry weight of broad leaves, grasses, sedges and total weeds were noticed under hand weeding at 20 and 40 DAS (6.05, 4.63, 4.21 and 8.62 g m^{-2}, respectively) which was found at par with hand weeding at 20 DAS + IC at 40 DAS (6.11, 4.98, 4.63 and 9.07 g m^{-2}, respectively), mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS (6.28, 5.42,

4.85 and 9.56 g m^{-2}, respectively) and sunnhemp straw mulch @7.5 t/ha *fb* HW at 30 DAS (6.43, 5.46, 4.95 and 9.70 g m^{-2}, respectively). Whereas, significantly higher dry weight of broad leaves, grasses, sedges and total weeds (9.55, 7.79, 7.53 and 14.49 g m^{-2}, respectively) were envisaged under weedy check due to higher number of weeds present in this treatment due to the absence of any weed control activity. The present outcomes were closely supported by Deva and Kolhe (2019), Shiv *et al.* (2023) and Sahu *et al*. (2020).

Weed control efficiency

Weed free treatment resulted 100% weed control efficiency across all the crop growth stages. The results made it abundantly evident that after the weed free treatment higher level of weed control efficiency at 25 DAS was recorded by hand weeding at 20 and 40 DAS (84.59 %) followed by hand weeding at 20 DAS + IC at 40 (82.99%) and stale seed bed *fb* HW at 30 DAS (77.28%). Furthermore, it was clear from the data that the maximum weed control efficiency at 50 DAS and at harvest was recorded by the weed free (100% and 100%, respectively) which was followed by hand weeding at 20 and 40 DAS (81.77 and 64.99%, respectively), hand weeding at 20 DAS + IC at 40 DAS (79.14 and 61.16%, respectively), *mustard* straw mulch @7.5 t/ha *fb* HW at 30 DAS (76.09 and 56.57%, respectively) and sunnhemp straw mulch @7.5 t/ha *fb* HW at 30 DAS (74.84 and 55.46%, respectively). Whereas, weedy check has recorded the lowest weed control efficiency at harvest.

Due to effective suppression of weeds by weed free, hand weeding at 20 and 40 DAS, hand weeding at 20 DAS + IC at 40 DAS, mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS and sunnhemp straw mulch @7.5 t/ha *fb* HW at 30 DAS, these treatments have witnessed lower weed dry weights of total weeds at 50 DAS and harvest (Table 3 and 4, respectively) and hence implied higher weed control efficiencies. Whereas, the lower values of weed control efficiencies observed in weedy check over rest of the treatments at harvest is due to no weed management practices undertaken during the crop growth period. The results are supported by Ram *et al.* 2015 and Dewangan *et al.* (2016).

Effect on yield attributes and yield

Weed free treatment was effective in producing significantly higher number of pods per plant (50.00), however, which was found statistically at par with hand weeding at 20 and 40 DAS (49.33), hand weeding at 20 DAS + IC at 40 DAS (43.53), mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS (43.33) and sunnhemp straw mulch @7.5 t/ha *fb* HW at 30 DAS (43.13).Significantly higher number of pods per plant recorded under weed free as well as hand weeding at 20 and 40 DAS, hand weeding at 20 DAS + IC at 40 DAS, mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS and sunnhemp straw mulch @7.5 t/ha *fb* HW at 30 DAS. The higher number of pods per plant is attributed to timely and efficient weed management that reduces competition for nutrients, water, and sunlight. This allows the crop to grow more vigorously, with better access to essential resources. These findings are in agreement with Pooniya *et al*. (2009) and Hargilas (2018). The data exhibited in Table 5 showed that the number of seeds per pod and seed index noted at harvest was not affected significantly due to different weed management practices. However, numerically the maximum seeds per pod (1.80) recorded with the treatment of weed free.

The results revealed that seed and stower yield of chickpea was significantly influenced due to different weed control treatments. Among the treatments, weed free treatment recorded significantly higher seed stower and yield (2573 and 4069 kg/ha) than other treatments but it was found on par with the treatments *i.e.* hand weeding at 20 and 40 DAS (2377 and 3815 kg/ha), hand weeding at 20 DAS + IC at 40 DAS (2305 and 3691 kg/ha), mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS (2223 and 3622 kg/ha) and sunnhemp straw mulch @7.5 t/ha *fb* HW at 30 DAS (2166 and 3559 kg/ha). While significantly lower seed yield (1320 and 2449 kg/ha) was recorded with weedy check treatment. Higher seed and stover yield in chickpea with weed free as well as hand weeding at 20 and 40 DAS, hand weeding at 20 DAS + IC at 40 DAS, mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS and sunnhemp straw mulch @7.5 t /ha *fb* HW at 30 DAS might be due to the absence of crop weed competition during critical crop growth stages which resulted in better utilization of all available resources resulting in higher seed and stover yield in chickpea. These results are in conformity with those obtained by Patel *et al.* (2006), Khope *et al*. (2011) and Sahu *et al*. (2020).

Effect on economics

Among all weed management practices, the higher net returns of 84,204 Rs. /ha was accrued under hand weeding at 20 and 40 DAS which was followed by weed free (T_5 82,112 Rs./ha), hand weeding at 20 DAS + IC at 40 DAS (T_6 81,224 Rs./ha), mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS (T_2 69,767 Rs./ha) and sunnhemp straw mulch @7.5 t /ha *fb* HW at 30 DAS (T_4 66,698 Rs./ha). Higher net returns realized with hand weeding at 20 and 40 DAS were due to higher yield (Table 7) with lesser cost of

cultivation compared to other weed control treatments tried in the experimentation. These results are in close conformity with the findings of Rathod *et al*. (2017) and Singh and Jain, 2017.Whereas, the highest benefit cost ratio of 2.58 was recorded under hand weeding at 20 and 40 DAS which was followed by hand weeding at 20 DAS + IC at 40 DAS (T_6 2.56), weed free (T_7 2.24), mustard straw mulch @7.5 t/ha *fb* HW at 30 DAS (T_2 2.18), and sunnhemp straw mulch @7.5 t/ha *fb* HW at 30 DAS (T_4 2.13). The increase in BCR was mainly due to proportionate increase in seed and stover yield of chickpea under adequate weed management. The results were corroborating the finding of Ratnam *et al*. (2011) and Rathod *et al*. (2017).

Conclusion

Based on results of one-year field experiment, it is concluded that higher seed yield and net returns can be secured through effective weed management in organic chickpea either from hand weeding at 20 and 40 DAS or weed free or hand weeding at 20 DAS + interculturing at 40 DAS or application of mustard straw mulch @7.5 t/ha *fb* hand weeding at 30 DAS or sunnhemp straw mulch @7.5 t/ha *fb* hand weeding at 30 DAS.

Table 1: Predominant weed flora observed in chickpea field

Sr. No.		Family	Scientific name	English name	Local name
A	**Broad leaves**				
	1	Amaranthaceae	*Chenopodium album* L.	White goosefoot	Chill
	2	Amaranthaceae	*Amaranthus spinosus* L.	Pig weed	Kantelli chauli
	3	Portulacaceae	*Portulaca oleracea* L.	Indian Purslane	Luni
	4	Nyctaginaceae	*Boerhavia diffusa* L.	Red spiderling	Biskhapra
	5	Amaranthaceae	*Digera arvensis* L.	False amaranth	Kanjira
	6	Papaveraceae	*Argemone Mexicana* L.	Maxican prickle poppy	Darudi
	7	Commelinaceae	*Commelina benghalensis* L.	Benghal day flower	Motun sismuliyu
	8	Euphorbiaceae	*Euphorbia hirta* L.	Pill pod spurge	Dudheli
	9	Euphorbiaceae	*Phyllanthus niruri* Hook F.	Senji/methi	Bhoy amali
	10	Lebiatae / Lamiaceae	*Leucas aspera* (Willd.) Link.	Maldoda	Kubi
B	**Grasses**				
	1	Poaceae	*Eragrostis pilosa* L. P. Beauv	Indian love grass	Bhoomsi
	2	Poaceae	*Dactyloctenium aegyptium* L.	Duck grass	Tarakiyu
	3	Poaceae	*Digitaria sanguinalis* L.	Crabgrass	Aarotaro
	4	Asphodelaceae	*Asphodelus tenuifolius*	Wild onion	Dungaro
	5	Gramineae	*Cynodon dactylon* L.	Bermuda grass	Dharo
C	**Sedge**				
	1	Cyperaceae	*Cyperus rotundus* L.	Nut sedge	Chidho

Table 2: Effect of different weed management practices on weed dry weight at 25 DAS in chickpea

Treatments	Weed dry weight (g m^{-2})			
	Broad leaves	**Grasses**	**Sedges**	**Total**
T_1: Stale seed bed *fb* HW at 30 DAS	3.06 (8.52)	1.96 (2.97)	1.96 (2.91)	3.91 (14.40)
T_2: Mustard straw mulch @7.5 t /ha *fb* HW at 30 DAS	5.02 (24.37)	2.83 (7.04)	2.42 (4.89)	6.10 (36.30)
T_3: Wheat straw mulch @7.5 t /ha *fb* HW at 30 DAS	5.41 (28.70)	3.10 (8.62)	2.88 (7.33)	6.73 (44.65)
T_4: Sunnhemp straw mulch @7.5 t /ha *fb* HW at 30 DAS	5.09 (24.97)	2.95 (7.71)	2.76 (6.69)	6.35 (39.36)
T_5: Hand weeding at 20 and 40 DAS	2.55 (5.54)	1.77 (2.17)	1.73 (2.05)	3.27 (9.76)
T_6: Hand weeding at 20 DAS + IC at 40 DAS	2.77 (6.66)	1.87 (2.60)	1.58 (1.52)	3.43 (10.78)
T_7: Weed free	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
T_8: Weedy check	6.39 (40.53)	3.69 (12.67)	3.33 (10.16)	8.01 (63.36)
S.Em. ±	0.31	0.17	0.14	0.24
C.D. at 5 %	0.95	0.53	0.43	0.74
C.V.%	13.83	12.59	11.20	8.68

Figures in parentheses are original values and outside are √x+1 transformed values

Table 3: Effect of different weed management practices on weed dry weight at 50 DAS in chickpea

Treatments	Weed dry weight (g m^{-2})			
	Broad leaves	**Grasses**	**Sedges**	**Total**
T_1: Stale seed bed *fb* HW at 30 DAS	7.74 (59.68)	5.40 (28.31)	4.77 (21.84)	10.5 (109.84)
T_2: Mustard straw mulch @7.5 t /ha *fb* HW at 30 DAS	4.73 (21.35)	3.99 (15.07)	3.07 (8.67)	6.77 (45.09)
T_3: Wheat straw mulch @7.5 t /ha *fb* HW at 30DAS	7.79 (60.27)	5.45 (29.00)	4.81 (22.31)	10.59 (111.58)
T_4: Sunnhemp straw mulch @7.5 t /ha *fb* HW at 30 DAS	4.76 (22.60)	4.11 (15.97)	3.13 (8.87)	6.92 (47.44)
T_5: Hand weeding at 20 and 40 DAS	4.07 (15.97)	3.54 (11.60)	2.78 (6.81)	5.94 (34.37)
T_6: Hand weeding at 20 DAS + IC at 40 DAS	4.33 (17.91)	3.81 (13.60)	2.92 (7.83)	6.33 (39.34)
T_7: Weed free	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
T_8: Weedy check	10.20 (103.20)	6.70 (44.33)	6.47 (41.05)	13.76 (188.58)
S.Em. ±	0.44	0.28	0.27	0.35
C.D. at 5 %	1.32	0.83	0.81	1.06
C.V.%	13.52	11.21	12.85	7.85

Figures in parentheses are original values and outside are √x+1 transformed values

Table 4: Effect of different weed management practices on weed dry weight at harvest in chickpea

Treatments	Weed dry weight (g m^{-2})			
	Broad leaves	**Grasses**	**Sedges**	**Total**
T_1: Stale seed bed *fb* HW at 30 DAS	7.93 (62.62)	6.33 (39.18)	5.89 (33.87)	11.66 (135.68)
T_2: Mustard straw mulch @7.5 t /ha *fb* HW at 30 DAS	6.28 (39.30)	5.42 (28.86)	4.85 (22.80)	9.56 (90.96)
T_3: Wheat straw mulch @7.5 t /ha *fb* HW at 30 DAS	7.95 (62.78)	6.41 (40.19)	5.93 (34.31)	11.73 (137.27)
T_4: Sunnhemp straw mulch @7.5 t /ha *fb* HW at 30 DAS	6.43 (40.58)	5.46 (29.03)	4.95 (23.67)	9.70 (93.28)
T_5: Hand weeding at 20 and 40 DAS	6.05 (35.67)	4.63 (20.69)	4.21 (16.97)	8.62 (73.33)
T_6: Hand weeding at 20 DAS + IC at 40 DAS	6.11 (36.58)	4.98 (23.99)	4.63 (20.77)	9.07 (81.35)
T_7: Weed free	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
T_8: Weedy check	9.55 (92.49)	7.79 (60.29)	7.53 (56.67)	14.49 (209.45)
S.Em. ±	0.49	0.37	0.39	0.39
C.D. at 5 %	1.48	1.11	1.19	1.17
C.V.%	13.22	12.05	13.98	7.06

Figures in parentheses are original values and outside are √x+1 transformed values

Table 5: Effect of different weed management practices on weed control efficiency in chickpea

Treatments	WCE (%)		
	At 25 DAS	**At 50 DAS**	**At harvest**
T_1: Stale seed bed *fb* HW at 30 DAS	77.28	41.76	35.22
T_2: Mustard straw mulch @7.5 t /ha*fb* HW at 30 DAS	42.71	76.09	56.57
T_3: Wheat straw mulch @7.5 t /ha*fb* HW at 30 DAS	29.52	40.83	34.46
T_4: Sunnhemp straw mulch @7.5 t /ha*fb* HW at 30 DAS	37.88	74.84	55.46
T_5: Hand weeding at 20 and 40 DAS	84.59	81.77	64.99
T_6: Hand weeding at 20 DAS + IC at 40 DAS	82.99	79.14	61.16
T_7: Weed free	100.00	100.00	100.00
T_8: Weedy check	-	-	-

Table 6: Effect of different weed management practices on yield attributes and yield of chickpea

Treatments	No. of pods per plant	No. of seeds per pod	Seed index (g)	Seed yield (kg /ha)	Stover yield (kg /ha)
T_1: Stale seed bed *fb* HW at 30 DAS	34.27	1.53	21.94	1759	2999
T_2: Mustard straw mulch @7.5 t /ha *fb* HW at 30 DAS	43.33	1.60	22.77	2223	3622
T_3: Wheat straw mulch @7.5 t /ha *fb* HW at 30 DAS	33.73	1.40	22.61	1668	2925
T_4: Sunnhemp straw mulch @7.5 t /ha *fb* HW at 30 DAS	43.13	1.67	21.84	2166	3559
T_5: Hand weeding at 20 and 40 DAS	49.33	1.67	22.31	2377	3815
T_6: Hand weeding at 20 DAS + IC at 40 DAS	43.53	1.73	22.37	2305	3691
T_7: Weed free	50.00	1.80	22.61	2573	4069
T_8: Weedy check	32.47	1.60	21.52	1320	2449
S.Em. ±	2.99	0.08	0.94	138.16	268.42
C.D. at 5 %	9.07	NS	NS	419	814
C.V. %	12.57	8.33	7.32	11.68	13.71

Table 7: Effect of different weed management practices on economics of chickpea

Treatments	Total cost of cultivation (Rs. /ha)	Gross returns (Rs. /ha)	Net returns (Rs /ha)	BCR
T_1: Stale seed bed *fb* HW at 30 DAS	57454	103147	45693	1.80
T_2: Mustard straw mulch @7.5 t /ha *fb* HW at 30 DAS	59244	129011	69767	2.18
T_3: Wheat straw mulch @7.5 t /ha *fb* HW at 30 DAS	83394	98460	15066	1.18
T_4: Sunnhemp straw mulch @7.5 t /ha *fb* HW at 30 DAS	59244	125942	66698	2.13
T_5: Hand weeding at 20 and 40 DAS	53281	137485	84204	2.58
T_6: Hand weeding at 20 DAS + IC at 40 DAS	52029	133253	81224	2.56
T_7: Weed free	66225	148337	82112	2.24
T_8: Weedy check	48271	78992	30721	1.64

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References

Adiyaman, C. and Kahriman, A. (2021). Determination of morphological resistance characteristics and of chickpea (*Cicer arietinum* L.) genetic sources to IMI group herbicides. *ISPEC Journal of Agricultural Sciences*, **5**(3): 678-689.

Anonymous (2023[a]). Agricultural statistics at a glance 2023. Directorate of Economics and Statistics, Department of Agriculture Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India.

Anonymous, (2023[b]). District wise area, production, yield of major crops of Gujarat State. Published by Directorate of Agriculture, Government of Gujarat, Gandhinagar.

Arif, M.; Cheema, Z. A.; Khaliq, A. and Hassan, A. (2015). Organic weed management in wheat through allelopathy. International Journal of Agriculture and Biology.**17**(1): 127-134.

Bhutada, P. O. and Bhale, V. M. (2013). Efficacy of herbicides and cultural manegement on weed control in gram (*Cicer arietinum*). *IOSR* Journal of Agriculture and Veterinary Science. **4**(5): 01-02.

Chavada, J. N.; Patel, C. K.; Patel, S. B.; Panchal, P. P. and Patel, G. N. (2017). Weed management in chickpea (*Cicer arietinum* L.) under north Gujarat conditions. International Journal of Science, Environment and Technology. **6**(3): 2018-2025.

Deva, S. and Kolhe, S.S. (2019). Irrigation time and weed management to enhance productivity of chickpea (*Cicer arietinum* L.). *International Journal of Fauna and Biological Studies*, **6**(3): 20-24.

Dewangan, M.; Singh, A. P.; Chowdhury, T. and Kumar, B. (2016). Management of complex weed flora in chickpea. *Indian Journal of Weed Science*, **48**(1): 79–82.

Dixit, A. K.; Kumar, S.; Rai, A. K. and Kumar, T. K. (2015). System productivity,profitability, nutrient uptake and soil health under tillage, nutrient and weed management in rainfed chickpea (*Cicer arietinum*)-fodder sorghum (*Sorghum bicolour*) cropping system. *Indian Journal of Agronomy*, **60**(2): 205-211.

Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research. IRRI, Willey-Inter Science pub., New York, UAS. p. 680.

Hargilas. (2018). Evaluation of effective weed management strategy for enhancing productivity and profitability of chickpea (*Cicer arietinum* L.) under rain-fed condition of southern Rajasthan. *International Journal of Current Microbiology and Applied Sciences.* **7**(11): 472-480.

Jodaugiene, D.; Pupaliene, R.; Urboniene, M.; Pranckietis, V. and Pranckietiene, I. (2006). The impact of different types of organic mulches on weed emergence. *Agronomy Research*. **4**:197-201.

Khope, D.; Kumar, S. and Pannu, R. K. (2011). Evaluation of post-emergence herbicides in chickpea (*Cicer arietinum*). *Indian Journal Weed Science.* **43** (1 and 2): 92-93.

Maurya, O. and Kumar, H. (2018). Growth of chickpea production in India. *Journal of Pharmacognosy and Phytochemistry*, **7**(5): 1175-1177.

Patel, B. D.; Patel, V. J.; Patel, J. B. and Patel, R. B. (2006). Effect of fertilizers and weed management practices on weed control in chickpea (*Cicer arietinum* L.) under middle Gujarat conditions. *Indian Journal of Crop Science*, **1** (1 and 2):180-183.

Pooniya, V.; Rai, B. and Jat, R. K. (2009). Yield and yield attributes of chickpea (*Cicer arietinum* L.) as influenced by various row spacings and weed control. *Indian Journal of Weed Science*. **41**(3 and 4): 222-223.

Ram, P. R.; Sreenivas, G.; Rani, P. L.; Madhavi, A. and Prakash, T. R. (2015). Impact of sustainable weed management practices on growth and yield of maize. 25th Asian-Pacific Weed Science Society Conference on Weed Science for Sustainable Agriculture, Environment and Biodiversity, Hyderabad, India.256.

Rathod, P. S.; Patil, D. H. and Dodamani, B. M. (2017). Integrated weed management in chickpea (*Cicer arietinum* L.) under rainfed conditions of Karnataka, India. *Legume Research-An International Journal*. **40**(3): 580-585.

Ratnam, M.; Rao, A. S. and Reddy, T. Y. (2011). Integrated weed management in chickpea (*Cicer arietinum* L.). *Indian Journal of Weed Science*. **43**(1 and 2): 70-72.

Sahu, M. P.; Kewat, M. L.; Jha, A. K.; Sharma, J. K. and Sondhia, S. (2020). Weed dynamics as affected by practices and straw mulches in chickpea. *International Journal of Chemical Studies*. **8**(4): 1857-1859.

Shiv, S.; Agrawal, S. B.; Verma, B.; Yadav, P. S.; Singh, R.; Porwal, M.; Sisodiya, J and Patel, R. (2023). Weed dynamics and productivity of chickpea as affected by weed management practices. *Pollution Research*. **42**(2): 21-24.

Singh, A. and Jain, N. (2017). Integrated weed management in chickpea. *Indian Journal of Weed Science*. **49**(1): 93-94.