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EFFECT OF HERBICIDE AND STRAW MULCH APPLICATION ON WEED MANAGEMENT IN GREENGRAM

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ABSTRACT

An experiment was conducted to evaluate the effect of herbicide and straw mulch application on weed management in greengram at Agricultural Experimental Farm, University of Calcutta, Baruipur, West Bengal during summer 2021 and 2022. Experiment consisted of seven treatments laid out in randomized block design (RBD) with three replications. The treatments consisted of pendimethalin @ 750 g a.i/ha as PE (T_1), quizalofop ethyl @ 50g a.i/ha at 15 DAS as PoE (T_2), pendimethalin @ 750g a.i/ha as PE + quizalofop ethyl @ 50g a.i/ha as PoE at 15 DAS (T_3), pendimethalin @750g a.i/ha as PE + HW at 15 DAS (T_4), paddy straw mulch @ 5t/ha (T_5), two hand weeding at 15 and 30 DAS (T_6) and weedy check (T_7). The results revealed that among the different weed management two hand weeding at 15 and 30 DAS (T_6) recorded the minimum weed density, weed dry matter and weed index along with pendimethalin @ 750g a.i/ha as PE + quizalofop ethyl @ 50g a.i/ha as PoE at 15 DAS (T_3) and pendimethalin @750g a.i/ha as PE + HW at 15 DAS (T_4). The higher weed control efficiency was also recorded in this treatment which resulted in improvement of growth parameters *viz.* plant height, branches per plant, nodules per plant and yield attributing characters *viz.* pods per plant and seeds per pod, and economic benefits compared to other treatments.

Keywords: chemical weed management, hand weeding, greengram, mulching.

Introduction

Greengram (*Vigna radiata* L.), commonly referred to as mungbean, is one of India's most significant pulse crops, valued for its high nutritional content and versatility. It is an excellent source of protein (approximately 24%), dietary fiber, vitamins, and minerals, making it a crucial part of the Indian diet, especially for vegetarian populations. Its low glycemic index and antioxidant properties also contribute to its increasing popularity in health-conscious markets. From an agronomic perspective, greengram is an integral crop for sustainable farming. As a legume, it fixes atmospheric nitrogen into the soil, improving soil fertility and reducing the dependency on synthetic fertilizers. Furthermore, it thrives in a variety of climatic conditions and is highly drought-resistant, making it a preferred crop in rainfed areas (Chauhan *et al.*, 2017). The short growth cycle of greengram allows it to fit seamlessly into multiple cropping systems, enhancing overall land productivity. Economically, greengram provides substantial income opportunities for small and marginal farmers due to its short duration and lower input costs. It also holds a prominent place in India's export market, with consistent demand for mungbean in Southeast Asian countries and beyond (Kumar and Sinha, 2019). Thus, promoting its cultivation is vital for ensuring food security, improving farmers' livelihoods, and supporting sustainable agricultural practices. However, weed infestation is a significant challenge, often reducing yield by 30–60% due to the crop's slow initial growth and short stature (Mahajan and Chauhan, 2021). Traditional practices, such as manual weeding, are labor-intensive and costly, while sole dependence on herbicides leads to resistance development, environmental concerns, and potential harm to soil health. Algotar *et al*. (2015) highlighted that severe weed infestations in greengram can lead to yield losses ranging from 30% to 80%. Therefore, it is crucial to develop cost-efficient weed management practices to improve both the productivity and profitability of greengram cultivation. Mulching is a crucial agricultural weed control technique. The amount of red light from the sun that reaches the ground surface may be lessened by straw mulch. Straw mulch may cause delayed or decreased emergence because most weeds need red wavelengths of sunlight to germinate. Furthermore, the emergence of weeds may be physically impeded by straw mulch. However, farmers must invest a lot of time and money in gathering, storing, and applying straw as mulch (Singh and Singh, 2020). Herbicidal treatment is required to manage weeds in green gram during periods of high weed infestation because to a lack of labor and rising labor costs. Applying herbicides at the right concentration is one of the greatest options for weed management. Herbicides are a cheap and efficient way to control weeds (Muoni *et al*., 2013). The proper application of pre-emergence (PE) and post-emergence (POE) herbicides aids in weed control at peak growth. According to Mishra *et al*. (2017), using pre- and post-emergence herbicides together, or certain ready-mix herbicide formulations, lessens crop weed competition and efficiently controls weed flora in green grams. In view of the above context, the present was undertaken during kharif 2022 to find out the most effective and economic method of weed control in greengram.

Materials and Methods

The field experiment was conducted during pre-*kharif* season of 2021 and 2022 at Agricultural Experimental Farm, Baruipur, South 24 Parganas. The soil of the experimental field had been of medium fertility, clay loam in nature, mildly acidic in reaction (pH 6.6) and indicative of West Bengal's new gangetic alluvial soil with low nitrogen (261 kg/ha), and high phosphorus (31 kg/ha) and potassium (317 kg/ha) content. The experiment was laid out in randomized block design (RBD) with seven treatments and three replications using short duration (65-70 days) greengram cultivar "WBM-29" which was released by Pulses & Oilseeds Research Station, Berhampore, West Bengal (2009). The seven treatments were of pendimethalin @ 750 g a.i/ha as pre-emergence (PE) (T_1), quizalofop ethyl @ 50g a.i/ha at 15 days after sowing (DAS) as post-emergence (PoE) (T_2), pendimethalin @ 750g a.i/ha as PE + quizalofop ethyl @ 50g a.i/ha as PoE at 15 DAS (T_3), pendimethalin @750g a.i/ha as PE + hand weeding (HW) at 15 DAS (T_4), paddy straw mulch @ 5t/ha (T_5), two HW at 15 and 30 DAS (T_6) and weedy check control (T_7). Seeds were sown at the rate of 20kg/ha and row to row distance was 30 cm and plant to plant 10 cm on 22nd march, 2022. After 10 days of sowing thinning and gap filling were done to maintain optimum plant population that is 10cm between plant to plant. The recommended fertilizer dose of 20:40:40 kg/ha N, P_2O_5 and K_2O were given at the field before sowing for nutrient management. Mulching was done using paddy straw. When the crop was physiologically matured, first picking was done on 8th May and 11th May followed by 2nd picking on 17th May and 21st May and last on 27th May and 31st May of 2021 and 2022 respectively. The ring area was harvested first to eliminate the border effects, then net plots were harvested separately and the produce was kept as such in respective plots for sun drying until constant weight was obtained. Five plants were randomly chosen from each plot and labelled for recording purposes in order to assess growth and yield characteristics. Each plot's weed population was counted separately within a 0.5 × 0.5 m area, and the results were represented as count per m^2. After that, the data was changed using the square root transformation $\sqrt{(x+0.5)}$ and translated to numbers per square meter. Weeds were gathered from every plot, cleaned, and oven-dried at 60 °C until a consistent weight was achieved for the weed dry weight. The weight of the oven-dried weeds was measured, recorded, and converted to g/m^2. Weed control efficiency (WCE) was calculated by using the dry weight of weeds (Mani *et al*., 1973) and expressed in percentage. To determine WCE (%) the following formula was used:

$$WCE\ (\%) = \frac{W_C - W_T}{W_C} \times 100$$

where, WCE = Weed control efficiency (%), WDW_C = Weed dry weight (aerial parts) in weedy check plot, and WDW_T = Weed dry weight (aerial parts) in treated plot. The weed index (WI) was calculated to quantify the percentage reduction in grain yield owing to the presence of weeds under various treatments. It was calculated using the following formula (Gill and Kumar 1969).

$$WI\ (\%) = \frac{Y_{WF} - Y_T}{Y_{WF}} \times 100$$

where, WI = Weed index (%), Y_{WF} = Yield of the crop in weed-free check, and Y_T = Yield of the crop in plot under weed control treatment. The economics of various weed management methods were calculated using the current input and output market prices. Benefit cost ratio was calculated by dividing net income (Gross return-total cost) with the total cost of the treatment.

Results and Discussion

Effect on weeds

Cynadon dactylon and *Setaria gluaca* were the two main grassy weed species identified in the experimental plots. In contrast, *Phyllanthus niruri*, *Melochia corchorifolia*, *Cammelina benghalensis*, and *Malachra capitata* were the broad leaf weed species identified in the experimental plots. *Cyperus rotundus* was the sole sedge found in the field. The most prevalent weed species in the experimental plots were *Setaria glauca*, *Malachra capitata*, *Melochia corchorifolia*, and *Cyperus rotundus*. All the weed management practices had significant impact on weed population at 25 DAS and 50 DAS (table 1). At 25 DAS significantly the lowest weed density was observed in two rounds (15+30 DAS) of HW which was statistically at par with pendimethalin @750g a.i/ha as PE + one HW at 15 DAS. At 25 DAS paddy straw mulch @ 5t/ha and treatment pendimethalin @ 750g a.i/ha as PE + quizalofop ethyl @ 50g a.i/ha as PoE at 15 DAS showed similar kind of weed compression. Significantly the lowest number of weeds per m^2 at 50 DAS was also found in two rounds (15+30 DAS) of HW which was closely followed by pendimethalin @750g a.i/ha as PE + one HW at 15 DAS. Similarly, the lowest weed biomass was found in two rounds (15+30 DAS) of HW followed by pendimethalin @750g a.i/ha as PE + one HW at 15 DAS on both 25 and 50 DAS. The reason behind low weed population in this treatment might be due to efficacy of pendimethalin, which has been observed to be effective against grasses and broad-leaf and to some extent of sedge weeds diminishes after 20 days of application. PE of pendimethalin followed by one additional hand weeding also kept the weed population lower than the rest of the treatments (Chhodavadia *et al.,* 2014; Patel *et al.,* 2016). As a result, on both 25 and 50 DAS the highest weed control efficiency (WCE) was noticed in two rounds (15+30 DAS) of HW followed by treatment pendimethalin @750g a.i/ha as PE + one HW (15 DAS). All the weed control treatments had shown decrease in WCE from 25 to 50 DAS. Paddy straw mulch of 5t/ha had better WCE *i.e* 77.13% and 58.41 % than single use of PE (29.42% and 23.49%) or PoE (40.24% and 29.84%) herbicide as well as both PE+PoE application of herbicides (74.55% and 36.83%) on both 25 and 50 DAS respectively. At harvest the lowest weed index (5.75) was found in the treatment of pendimethalin @750g a.i/ha as PE + one HW at 15 DAS followed by treatment pendimethalin @ 750g a.i/ha as PE + quizalofop ethyl @ 50g a.i/ha as PoE at 15 DAS. Whereas maximum weed index of 71.31 was observed in weedy plot.

Table 1 : Effect of treatments on weed population, weed biomass, weed control efficiency and weed index during 2021 and 2022; mean over two years.

Treatments	Weed density (No/m^2)		Weed dry weight (g/m^2)		Weed control efficiency (%)		Weed Index
	25 DAS	50 DAS	25 DAS	50 DAS	25 DAS	50 DAS	Harvest
T_1-	5.92 (34.67)	8.13 (65.67)	6.29 (39.44)	8.97 (80.33)	29.42	23.49	36.69
T_2-	5.27 (27.33)	7.79 (60.33)	5.82 (33.39)	8.59 (73.67)	40.24	29.84	43.09
T_3-	4.81 (22.67)	6.92 (47.67)	3.83 (14.22)	8.16 (66.33)	74.55	36.83	16.10
T_4-	3.96 (15.33)	5.67 (31.67)	3.35 (10.76)	6.14 (37.33)	80.74	64.44	5.75
T_5-	4.81 (22.67)	7.29 (53.00)	3.64 (12.78)	7.84 (61.33)	77.13	58.41	38.89
T_6-	3.72 (13.33)	4.77 (22.33)	2.93 (8.08)	5.44 (29.33)	85.54	72.06	-
T_7-	7.65 (58.00)	9.58 (91.33)	7.49 (55.88)	10.26 (105.00)	-	-	71.31
SEm ±	0.19	0.25	0.24	0.27	-	-	-
C.D. (P=0.05)	0.61	0.77	0.74	0.82	-	-	-

Figures in parentheses indicate original values which were subjected to square root transformation $\sqrt{(x+0.5)}$.

Effects on crop

Plant height at harvest was significantly affected by different weed control treatments. Maximum plant height was recorded in two round of HW (15+30 DAS) which was statistically at par with pendimethalin @750g a.i/ha as PE + one HW at 15 DAS and pendimethalin @ 750g a.i/ha as PE + quizalofop ethyl @ 50g a.i/ha as PoE at 15 DAS. This result is in line with Kaur *et al.*, (2010). Similar kind of trend was observed in number of branches per plant also at harvest. This could be because there was very little crop-weed competition for different growth factors under these treatments, which had the lowest population of weed flora as well as the lowest weed dry weight, giving the crop a better opportunity to utilize nutrients, moisture, light, and space for proper growth and development at early stage of the growth period. Significantly the highest number of nodules per plant and number of pods per plant were found in two round of HW (15+30 DAS) which was closely followed by PE of pendimethalin @ @750g a.i/ha along with one HW at 15 DAS and combined application of pendimethalin @ 750g a.i/ha as PE + quizalofop ethyl @ 50g a.i/ha as PoE at 15 DAS. Similar kind of result was reported by Mishra *et al.* (2017) and Singh *et al.* (2017). All the weed control treatments showed statistically similar result in number of seeds per pod except the control plot. The highest seed yield was observed in two round of HW (15+30 DAS) which was statistically at par with PE of pendimethalin @ @750g a.i/ha along with one HW at 15 DAS and combined application of pendimethalin @ 750g a.i/ha as PE + quizalofop ethyl @ 50g a.i/ha as PoE at 15 DAS. Pre emergence application of herbicide kept the soil weed free from the early stage of crop growth that shift the crop-weed competition in favour of crop. After that one additional hand weeding helps minimum weed infestation almost similar to weed free situation (two hand weeding). Straw mulching seems not so effective in this experiment to weed control in greengram because it was observed that weeds germinate in between mulching. May be 5 t/ha mulching is not enough to cover the soil. Maximum 2.37 of benefit cost ratio was recorded in pendimethalin @ 750g a.i/ha as PE + quizalofop ethyl @ 50g a.i/ha as PoE at 15 DAS followed by PE of pendimethalin @ @750g a.i/ha along with one HW at 15 DAS (2.15). Mulching in greengram had found only 0.96 BCR in comparison with two round of HW 1.80.

From the above experiment in can be concluded that PE of pendimethalin @ 750g a.i/ha along with HW can give maximum greengram yield whereas more economic benefit can be obtained from pre emergence followed by post emergence application of herbicide in greengram because of the intensive labour charges in hand weeding.

Table 2 : Effect of treatments on greengram growth, yield parameter and economics during 2021 and 2022; mean over two years

Treatments	Plant height (cm)	Number of branches/ plant	Number of nodules/ plant	Number of pods/ plant	Number of seeds/ pod	Seed yield (kg/ha)	Benefit: cost ratio
T_1-	62.83	8.67	5.67	27.67	11.33	815.03	1.83
T_2-	60.5	8.00	5.00	23.67	10.00	732.67	1.34
T_3-	68.5	10.67	6.67	35.00	11.00	1080.00	2.37
T_4-	71.53	11.33	7.00	38.00	11.00	1213.33	2.15
T_5-	65.17	9.33	5.33	31.33	11.33	786.67	0.96
T_6-	72.67	12.67	7.33	42.00	11.67	1287.30	1.80
T_7-	50.33	5.67	2.67	12.00	9.00	369.33	0.38
SEm ±	1.48	0.76	0.33	1.96	0.59	70.43	-
C.D. (P=0.05)	4.57	2.36	1.04	6.03	1.83	217.00	-

Fig. 1: Effect of weed management treatments on plant height

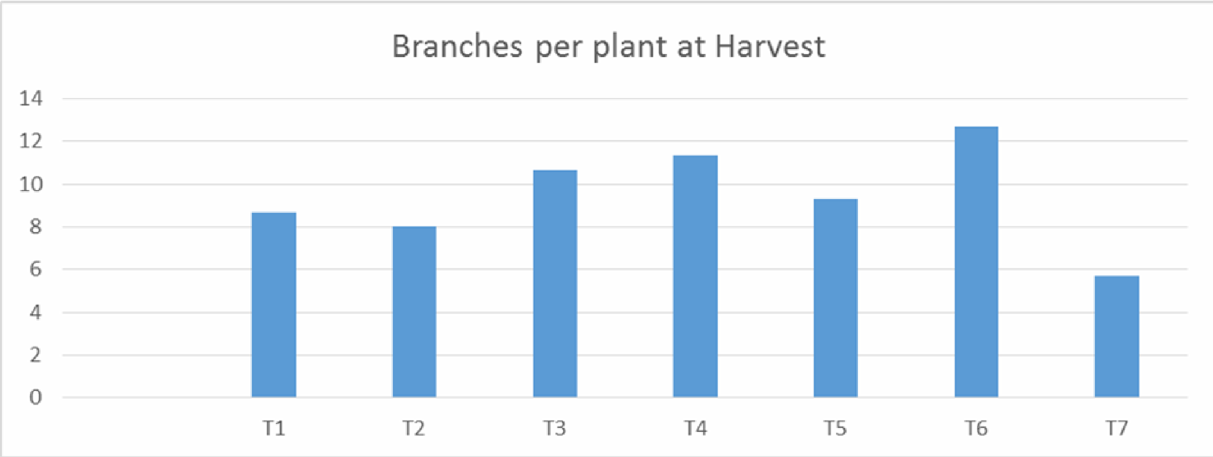

Fig. 2: Effect of weed management treatments on number of branches per plant.

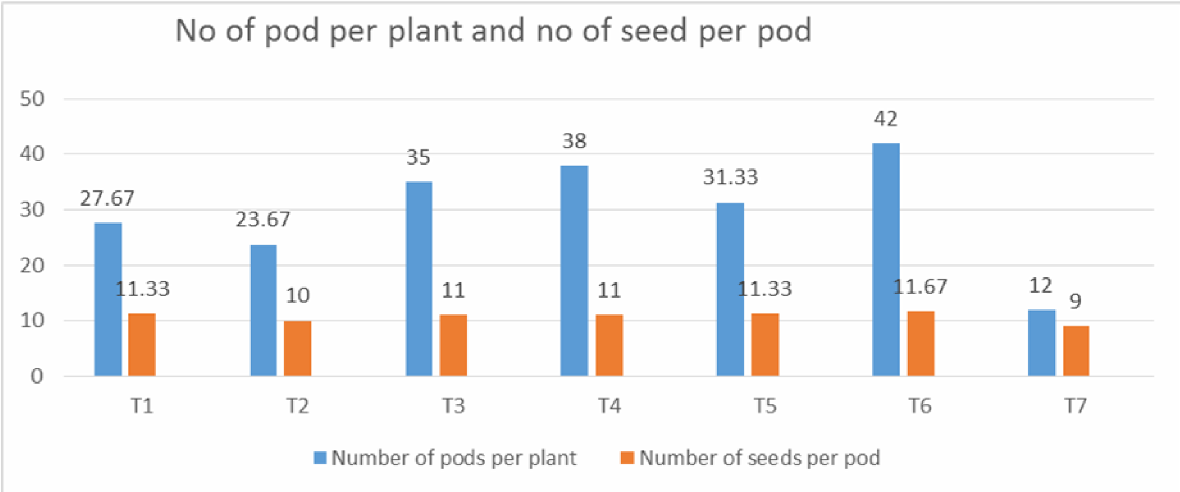

Fig. 3: Effect of weed management treatments on yield attributes.

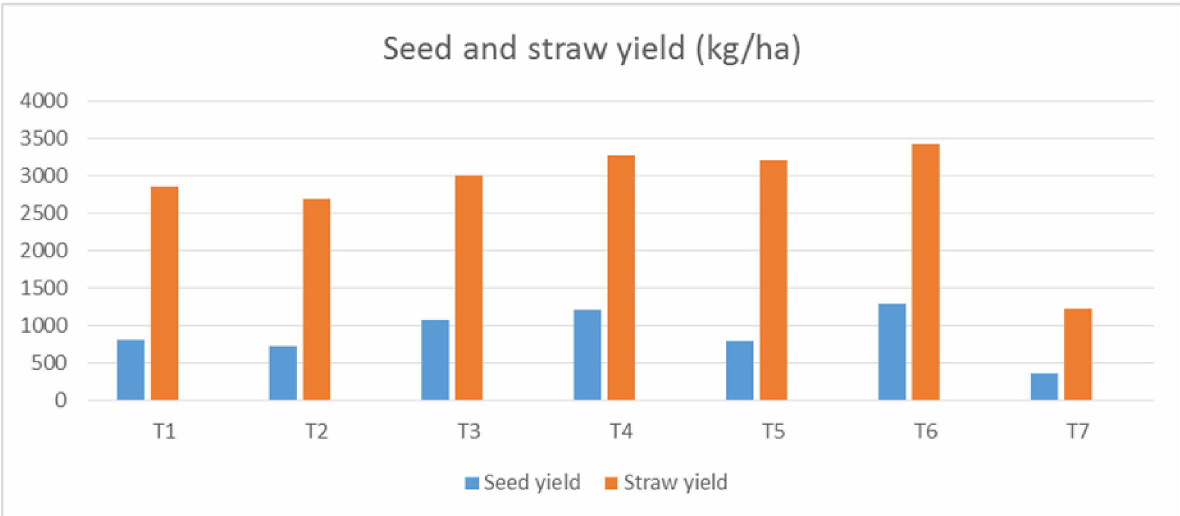

Fig. 4: Effect of weed management treatments on yields.

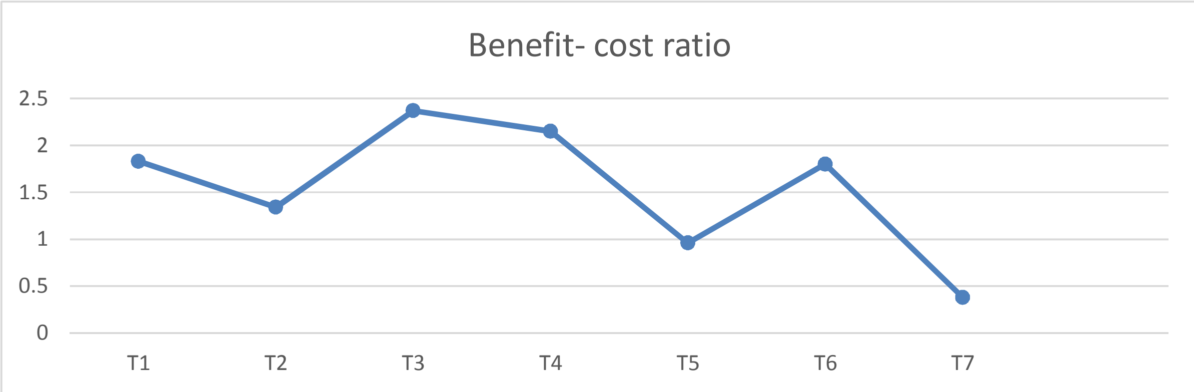

Fig. 5: Effect of weed management treatments on benefit- cost ratio.

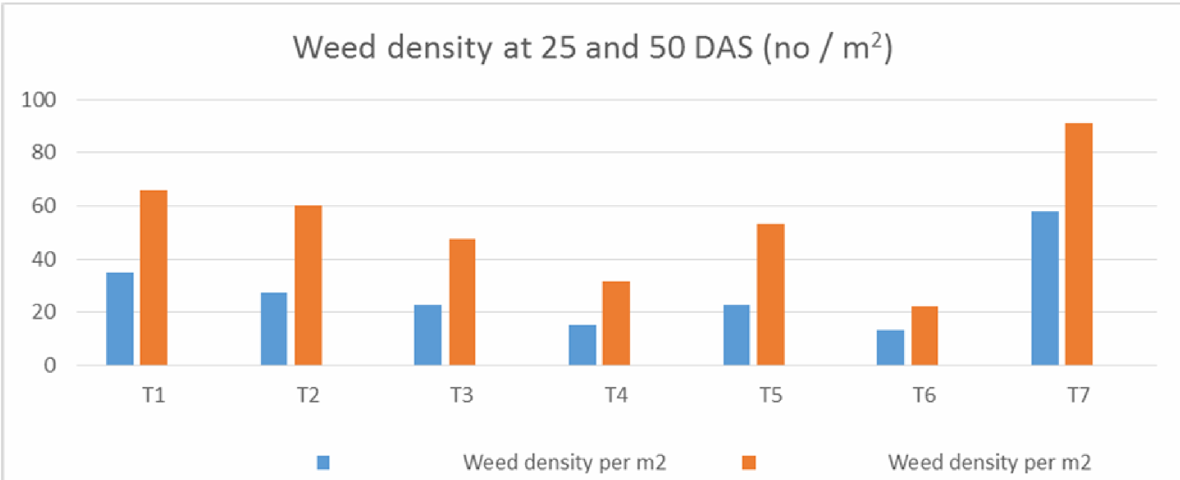

Fig. 6: Effect of weed management treatments on weed density.

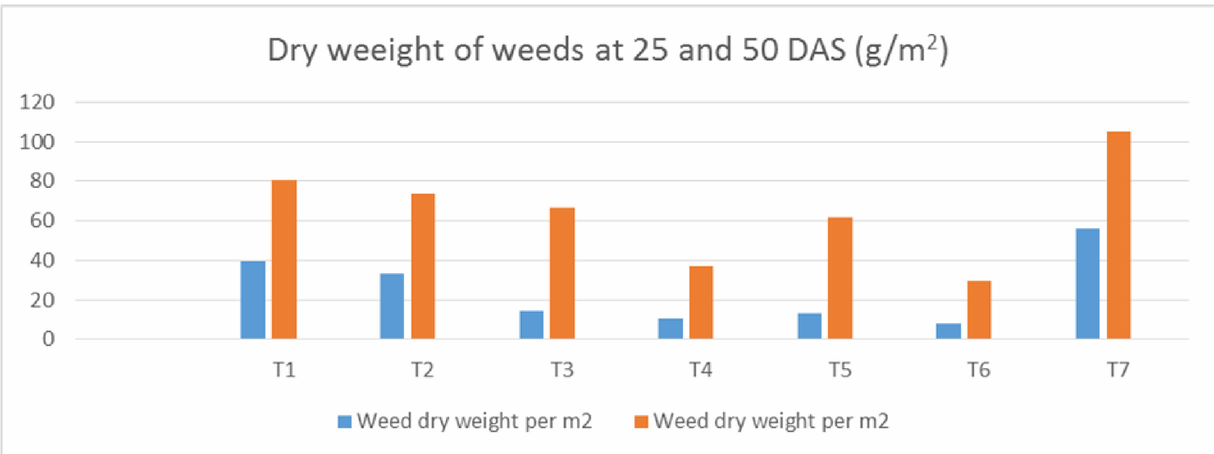

Fig. 7: Effect of weed management treatments on weed dry weight.

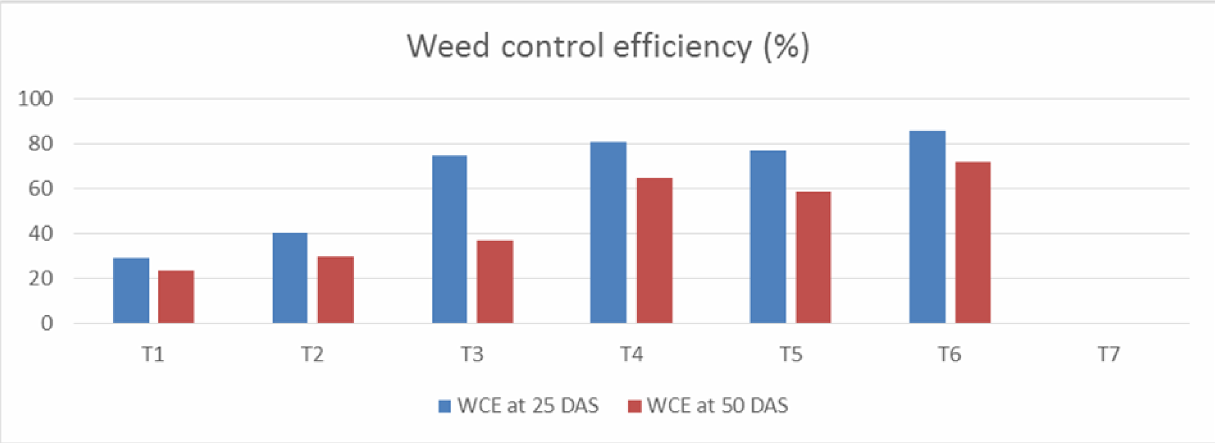

Fig. 8: Effect of weed management treatments on weed control efficiency.

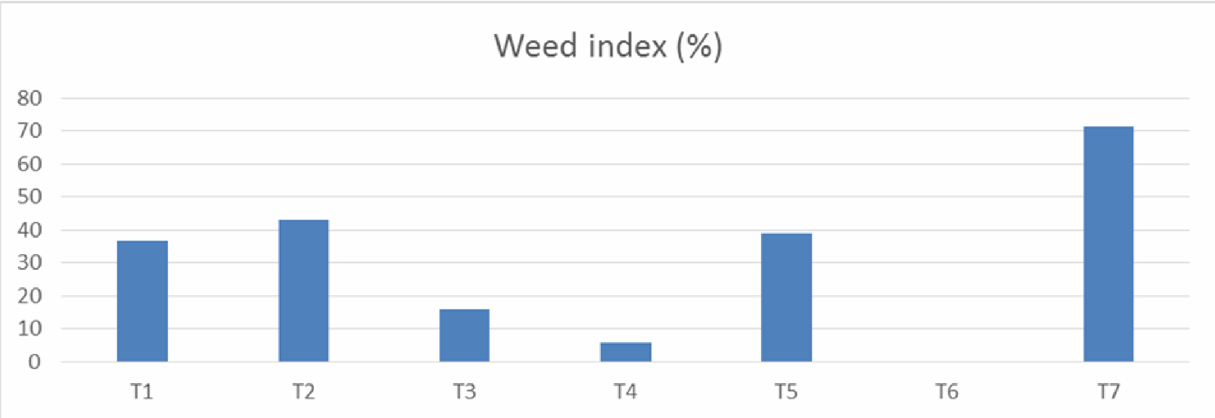

Fig. 9: Effect of weed management treatments on weed index

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