EFFECT OF INTEGRATED WEED MANAGEMENT ON GROWTH AND YIELD OF WHEAT (*TRITICUM AESTIVUM* L.) UNDER IRRIGATED CONDITIONS OF PUNJAB

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ABSTRACT

A field experiment was conducted at Campus for Research and Advanced Studies, Dhablan, G.S.S.D.G.S. Khalsa College, Patiala to study the "Effect of integrated weed management on growth and yield of wheat (Triticum aestivum L.) under irrigated conditions of Punjab" during rabi season of 2016-17 using randomized block design with three replications. The experiment comprised of eleven weed management practices as treatments. The soil of experimental field was clayey in texture with pH (7.3), organic carbon (0.65%), low in available nitrogen (276.28 kg ha^{-1}), medium in available phosphorous (19.62 kg ha^{-1}) and medium in available potassium (145.69 kg ha^{-1}). All weed control treatments recorded significantly lesser weed population and dry matter of weeds than weedy check. Among the herbicides treatments, hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS (T_{10}) (T_{10}) was found to be the best treatment for controlling weed population and obtaining higher weed control efficiency. The growth parameters such as plant height, leaf area index, number of tillers and dry weight per plant, and yield attributes viz. effective tillers, spike length, grains per spike and test weight were significantly influenced by this treatment as compared to control. Application of hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS significantly increased grain yield by 43.73 per cent over control. So, it could be concluded that treatment T_{10} (HW at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS) can be adopted for reducing weed growth and enhancement of yield attributes and yield of wheat crop with profitable economics (B:C ratio = 2.97).

KEY WORDS: Grain yield, Hand weeding, Sulfosulfuron, Weed management, Wheat

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the major grown cereal crop of India and is widely grown and utilized all over the world. It belongs to *Poaceae* family and it is an annual self-pollinated crop. It is a grown in *rabi* season in temperate regions and also at higher altitude under tropical climatic areas in winter season. At present in India, total area under this crop during 2015-16 was 30.23 million hectare. Its total production in the country was 93.50 million tone with 30.93 quiantal per hectare, productivity. It is mainly grown in states like Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Gujarat and Maharashtra. In Punjab, wheat occupied 3.50 million hectare of area with the

production of 16.08 million tone and average productivity was 45.96 quintal per hectare during 2015-16 (Anon., 2016). As compared to national average, the area and production of wheat in Punjab state is 11.57 and 17.20 per cent, respectively.

Weeds are considered as one of the most destructive disaster for crop production due to its competition with the crop plant for the nutrition and other components like light, moisture and space. Due to weeds, there is increase in harvesting costs, require costs cleaning of seeds and clog water ways (Ashrafi *et al.,* 2009). Weeds are highly yield reducers that are, in several situations, economically very important than insects, fungi and other pest organisms (Savary *et al.*, 2000). The biggest problem under high input wheat production system is interference of weeds which alone cause major reduction in crop yield. Weeds competition in wheat is a core point in reduction of yield (Zand *et al*., 2003). Many researchers, all over the world surveyed that weed has caused a great loss to the wheat yield. The study conducted in Palampur reported that uncontrolled weed growth depleted the NPK 83.4, 18.7 and 80.8 kg ha^{-1}, respectively, which was higher than the total uptake of these nutrients by wheat crop (Kumar *et al*., 2005). Wheat infestation by multifarious weed flora comprising both narrow as well as broad leaf weeds causing yield reduction of 15-40 per cent depending upon type and intensity of their infestation (Jat *et al*., 2003). Wheat crop is highly infested with grassy and broad leaved weeds like *Parthenium hysterophorous, Portulaca oleracea, Euphorbia mollis, Amaranthus viridis, Convolvulus arvensis, Commelina benghalensis, Chenopodium album, Cyperus rotundus, Sonchus arvensis,* etc. In India, presence of grassy and broad leaved weeds in general reduces crop yield by 31.5 percent in *rabi* and 36.5 per cent in *kharif* season and in many cases lead to complete destruction of the crop (Anon., 2007). The seed of *Phalaris minor* germinate mostly from shallow depth, deep ploughing after wheat harvest can bury the seed and have intense effect on its germination. If the population density of weed *Phalaris minor* increased, the dry matter accumulation, number of tillers and crop yield decreased to a large extent. The population of 15 plants per meter square of *Phalaris minor* reduces the crop yield up to 14 per cent.

There are several methods to control the weeds like cultural, mechanical, physical and chemical methods, are commonly used for controlling weeds. The weed cannot be controlled timely, in peak season due to unavailability of labour as well as unfavourable weather conditions. Therefore, weed control alone mechanical is not feasible. Chemical weed control is an important alternative along with hand weeding. Herbicides have shown to be beneficial and very effective means of controlling weeds in wheat crop. The choice of suitable herbicide at proper time with proper dose is the most important consideration for profitable returns (Fayad *et al*., 1998). Combination of narrow and broad leaf herbicides was much better than their separate application to control the weed in wheat crop. The regular use of herbicides such as isoproturon not only resulted into herbicidal resistance in *Phalaris minor* but also caused weed shifts. The herbicide, 2,4-D has been found very effective for the control of broad-leaved weeds in wheat, but its improper use led to ear deformation (Tiwari *et al*., 2005). It is a systemic herbicide which kills only broad leaf weeds, but not effective on grasses such as *Phalaris minor*. Recently, new compounds like sulfosulfuron have been found to be very effective against *Phalaris minor* in wheat. It is a selective type early post emergence herbicide used for effective control of narrow and broad leaf weeds *viz*., *Phalaris*

minor, *Chenopodium album* and *Melilotus alba* of wheat crop. Metribuzin has been reported effective against associated weeds of wheat crop (Dixit and Bhan 1997).

With these considerations in view, the present investigation entitled "Effect of integrated weed management on growth and yield of wheat (*Triticum aestivum* L.) under irrigated conditions of Punjab" was planned and undertaken.

MATERIALS AND METHODS

The present study entitled "Effect of integrated weed management on growth and yield of wheat (*Triticum aestivum* L.) under irrigated conditions of Punjab" was carried out at Campus for Research and Advanced Studies, Dhablan, G.S.S.D.G.S Khalsa College, Patiala during the *rabi* season of 2016-17. The field trail was laid out in randomized block design with eleven treatments [T_1=Weed check (control), T_2=Weed free, T_3=Hand weeding at 40 DAS, T_4=Metribuzin @ 75 g ha^{-1} at 30 DAS, T_5= Metribuzin @ 100 g ha^{-1} at 30 DAS + hand weeding at 45 DAS, T_6=Sulfosulfuron @ 25 g ha^{-1} at 30 DAS, T_7= Sulfosulfuron @ 40 g ha^{-1} at 30 DAS, T_8=2,4-D @ 0.75 kg ha^{-1} at 35 DAS, T_9=2,4-D @ 1.00 kg ha^{-1} at 35 DAS, T_{10}= Hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1}at 35 DAS, and T_{11}= Hand weeding at 25 DAS+ 2,4-D @ 0.75 kg ha^{-1}at 35 DAS] in three replications. Before planting of wheat crop mechanical and chemical analysis of composite soil samples were performed to determine the status of soil in the year 2016-17.

The soil of experimental field was clayey in texture with pH (7.3), organic carbon (0.65 %), low in available nitrogen (276.28 kg ha^{-1}), medium in available phosphorous (19.28 kg ha^{-1}) and medium in available potassium (145.69 kg ha^{-1}). Five plants were randomly selected for taking all observations and analysis for yield estimation. The grain yield was worked out on net plot yield. The analysis and interpretation of data were done by using OPSTAT developed by CCS HAU, Hisar and as per randomized block design (Panse and Sukhatme, 1985). The benefit cost ratio was calculated on the basis of formula as B:C ratio=Total returns/Total cost of cultivation.

RESULTS AND DISCUSSION

Weed studies

Weed performance of wheat varied significantly with application of weed management (Table 1) over control.

Population of weeds (m^{-2})

Different weed management treatments marked their significant effect on weed count at 30, 60, 90 and 120 DAS. Among different treatments, weed free treatment proved the most effective to reduce the weed population (Table 1). The population of narrow weed species *viz. Phalaris minor* and broad leaf weeds *viz. Chenopodium album*, *Anagallis arvensis*, *Convolvulus arvensis* were reduced drastically with different herbicide treatments at different stages of crop growth. The lowest weed population was recorded in weed free treatment. Among the herbicides, hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS and hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS were found effective controls the broad leaf as well as narrow leaf weeds. These treatments found equivalent effective or par to each other. This might be due to effective control of weeds at early stages of crop with application of hand weeding and in later stages with the use of herbicides. The highest weed count was recorded under unweeded control, which was due to the absence of weed control practices. Effectiveness of weed free treatment and hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS and hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS have been also reported by Pradhan and

Chakraborti (2010), Bharat *et al*. (2012), Saquib *et al*. (2014) and Verma *et al*. (2017).

Weed dry weight (g m^{-2})

Among different treatments, weed free treatment proved superior to reduce dry weed weight (Table 1). Among the herbicides, hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS significantly reduce dry weed weight and it was at par with hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS. This was due to lower weed population under these treatments could be attributed to effective weed control. Significantly the highest dry weight of weeds was observed under unweeded check. The findings corroborate with those of Kumar and Agarwal (2011), Saquib *et al*. (2014), Amare *et al*. (2016) and Verma *et al*. (2017).

Weed control efficiency (percent)

Among different weed management treatments, the highest weed control efficiency was observed with weed free treatment (Table 1). Among the herbicides treatments, hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS recorded the maximum weed control efficiency (87.93, 75.79, 75.69 and 67.77 % at 30, 60, 90 and 120 DAS) and which were at par with T_{11} (hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS) except at 120 DAS. This was due to lower weed population and lower dry weight of weeds during initial stages by hand weeding and control of weeds later with post emergence herbicides, which provide weed free and congenial environment to the crop. The lowest weed control efficiency was observed under control. The findings are in closely related with Bharat *et al*. (2012), Kumari *et al*. (2013), Yadav and Dixit (2014) and Saquib *et al*. (2014).

Weed index (percent)

Different treatments of weed control exerted their remarkable effect on weed index and the lowest weed index was recorded under weed free treatment with 0 per cent which were represented in Table 1. Among the herbicides treatments, hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS (T_{10}) recorded significantly lower weed index which was closely at par with hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS. (T_{11}). This might be due to better control of weeds in these treatments which resulted into minimum loss of grain yield of crop. The result could be supported by studies of Saquib *et al*., (2014) in the earlier period.

Crop studies

Plant height (cm)

Plant height is major index of crop growth. Plant height was influenced significantly with the application of different weed control treatments at all crop growth stages. Weed control treatments increase crop growth and thereby along with plant height. Reduction in plant height in unweeded control treatment might be due to heavy weed growth, which competes with the crop plants to the maximum extent which affect the crop growth. Taller plants were produced under weed free treatment (Table 2). Among the other treatments, T_{10} (hand weeding at 25 DAS+ Sulfosulfuron @ 25 g ha^{-1} at 35 DAS) produced taller plants which was at par with T_{11} treatment. These results are in agreement with the findings of Pradhan and Chakraborti (2010), Paighan *et al*. (2013), Pisal and Sagarka (2013), Singh *et al*. (2015) and Verma *et al*. (2017).

Number of tillers (m^{-2})

Tillering has a direct influence on yield of wheat crop. The number of tillers was increased from 30 DAS after sowing to 90 DAS and thereafter, number of tillers was decreased at 120 DAS as given in Table 2. Weed free treatment increased the number of tillers m^{-2} and maximum number of tillers were obtained with T_{10} (hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35

DAS) and was at par with T_{11} (hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS). This may be due to that there was very little crop weed competition under this treatments as recorded the lowest population of narrow and broad leaf weeds as well as the lowest weed dry weight. These results corroborate with the findings of Yadav and Dixit (2014), Singh *et al*. (2015) and Verma *et al*. (2017).

Leaf area index

Leaf area index is yardstick for measuring the photosynthetic efficiency of crops. Weed control treatments had the positive effect on leaf area index at crop growth stages of wheat. Data regarding leaf area index of wheat showed that it was increased from the beginning of crop growth stage up to 90 DAS and afterwards it decreased. The maximum leaf area index was observed with weed free treatment and among herbicide treatment T_{10} (hand weeding at T_{11} (25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS) recorded higher LAI which remained at par with hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS (Table 2). Less crop weed competition and better weed control efficiency resulted in profuse growth of crop in weed free treatment may be responsible for higher LAI. Leaf area index was the lowest in unweeded check may be due to severe weed growth has adverse effect on growth of wheat. Similar results were obtained by Singh *et al*. (2013).

Dry weight (g plant^{-1})

The dry weight per plant of wheat plant increased continuously with the advancement in the crop age up to harvest of the crop. The treatment weed free recorded statistically the highest dry weight per plant at all stages of observations *viz.*, 30, 60, 90, 120 DAS and at harvest than all other treatments under study (Table 3). Among other treatments, hand weeding at T_{11} (25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS recorded higher dry weight per plant and it was found to be at par with hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS. The higher dry weight per plant in these treatments might be due to lower population and dry weight of weeds. Significantly lower values of dry weight per plant were observed in unweeded control, which might be due to higher number of weeds and their dry weight in this treatment. Similar findings were also reported by Pradhan and Chakraborti (2010) and Verma *et al*. (2017).

Yield attributes

Different weed control treatment has significant effect on various yield attributes *viz*., number of effective tillers m^{-2}, spike length, number of grains per spike and test weight. The maximum number of effective tillers and grains per spike was observed with weed free treatment (Table 3). Among herbicides, T_{10} (hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1}at 35 DAS recorded the maximum effective tillers and grains per spike, which remained at par withT_{11} (hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS). Similar increase in spike length and test weight was also observed in these treatments. Increased values in these yield attributes might have been on account of overall improvement in vegetative growth due to less population of weed especially broad and narrow leaf weeds in the plots treated with these herbicides which favourably influenced the tillering, flowering and fruiting and ultimately resulted into the maximum spike length, more number of grains $spike^{-1}$ and test weight. The lowest values of all these yield attributes were found in unweeded control, which might be due to heavy crop weed competition in this treatment which effects the crop growth, resulted into the lowest yield attributes. These results are in close vicinity with findings of Gopinath *et al*. (2007) and Verma *et al*. (2017) with respect to number of effective tillers;

Pradhan and Chakraborti (2010), Paighan *et al*. (2013), Nanher *et al*. (2015) and Tiwari *et al*. (2017) for spike length; Amare (2014), Verma *et al*. (2017), Kumar and Agarwal (2011) and Paighan *et al*. (2013) for grains spike^{-1}; and Pradhan and Chakraborti (2010), Yadav and Dixit (2014), Nanher *et al*. (2015), Verma *et al*. (2017) for test weight.

Yield

Grain yield (q ha^{-1})

All the weed control treatments significantly increased the grain yield of wheat. The highest grain yield was recorded in weed free treatment (Table 3). Among other herbicidal treatments, T_{10} (hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS) recorded higher grain yield and it was on par with (hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS). The highest grain yield in these treatments was due to effective suppression of narrow and broad leaf weeds in the early stages of crop growth, which was evidenced from the maximum growth parameters and yield attributes. The superiority of these treatments over weedy check in increasing grain yield has also been reported by Gopinath *et al*. (2007), Kumar and Agarwal (2011), Singh *et al*. (2013) and Amare (2014).

Straw yield(q ha^{-1})

Data presented in Table 3 indicated that different weed control treatments significantly influenced the straw yield of wheat crop. Weed free treatment produced the maximum straw yield of wheat. The maximum straw yield produced by treatments T_{10} (hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35DAS), which was at par with T_{11} (hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1} at 35 DAS). Higher straw yield was attributed to increase in growth parameters *viz.*, plant height and dry weight per plant and yield attributes, which favour accumulation of more sink which ultimately increased the straw yield. Weed free treatment and Sulfosulfuron control the weeds at early stages of crop growth and maintains lower weed infestation till the harvest of the crop and influenced the crop growth which subsequently increases the straw yield. It is in agreement with the views of Pisal and Sagarka (2013), Saquib *et al*. (2014), Nanher *et al*. (2015) and Tiwari *et al*. (2017).

Economics

The choice of any weed control method ultimately depends on economics and efficiency in controlling weeds. The economics of different treatments presented in Table 4 revealed that the maximum gross returns were recorded under weed free treatment but maximum net returns and B: C ratio was recorded under T_{10} treatment. Significantly the lowest gross return, net returns and B: C ratio was recorded under unweeded control in T_1. The highest net returns with B: C ratio of 2.97 in T_{10} treatment might be due to effective weed control, higher yield and lower cost of herbicide used in this treatment. The lowest net returns and B:C ratio under T_1 treatment might be due to excessive weed growth in this treatment which resulted to lower yield than other treatments. These results are same as with the findings of Gopinath *et al*. (2007), Sharma and Singh (2011) and Saquib *et al*. (2014).

CONCLUSION

On the basis of experimental findings, it is concluded that weed free treatment had significant effect on weed control measures such as weed density, dry weight of weed, weed index and weed control efficiency of controlling weed growth in wheat. Among the herbicides, T_{10} (Hand weeding at 25 DAS + Sulfosulfuron @ 25 g ha^{-1} at 35 DAS) treatment proved its superiority in significantly increasing in growth parameters, yield attributes, yield,

quality and economics of wheat, reducing weed density, dry weight of weed, weed index and improving weed control efficiency of controlling weed population in wheat. The second best treatment is T_{11} (Hand weeding at 25 DAS + 2,4-D @ 0.75 kg ha^{-1}at 35 DAS). Based on the findings of the experiment, it is concluded that the maximum weed control, highest production and profit can be achieved by handweeding at 25 DAS along with application of Sulfosulfuron at 35 DAS @ 25 g ha^{-1}. However, for the confirmation of the above experimental findings further research work is necessary along with multilocational trials in different types of soil along with different agroecological regions and repetition of this experiment for more years so that more précised results were achieved.

REFERENCES

Amare, T. (2014). Effect of weed management methods on weeds and heat (*Triticum aestivum* L.) yield. *African J. Agril. Res.,* **9**(24): 1914-1920.

Amare, T.; Raghavaiah, C. V. and Zeki, T. (2016). Productivity, yield attributes and weed control in wheat (*Triticum aestivum* L.) as influenced by integrated weed management in central high lands of Ethiopia, East Africa. *Adv. Crop Sci. Technol.,* **4**: 1-7.

Anonymous. (2007). Vision 2025. NRCWS Perspective Plan. Indian Council of Agricultural Research (ICAR), New Delhi. pp. 103-112.

Anonymous. (2016). Agricultural Statistics at Glance-2016. GOI, Ministry of Agriculture & Farmers Welfare Department of Agriculture, Cooperation & Farmers Welfare Directorate of Economics and Statistics. pp. 90-92.

Ashrafi, Z. Y.; Mashadi, H. R.; Sadeghi, S. and Blackshaw, R. E. (2009). Study effects of planting methods and tank mixed herbicides on weeds controlling and wheat yield. *J. Agric. Sci.,* **1**(1): 101-111.

Bharat, R.; Kachroo, D.; Sharma, R.; Gupta, M. and Sharma, A. K. (2012). Effect of different herbicides on weed growth and yield performance of wheat. *Indian J. Weed Sci.,* **44**(2): 106-109.

Dixit, A. and Bhan, V. M. (1997). Efficiency of metribuzin for controlling weeds in wheat. *Annual Report of National Research Centre for Weed Science*. pp. 23.

Fayad, T. B.; Sabry, S. R. S. and Aboul, E. S. H. (1998). Effect of herbicides on weed density, wheat grain yield, and yield components. *Conference on Weed Biology and Control. Stuttgart Hohenheim, Germany*, 14 March, 1998.

Gopinath, K.A.; Kumar, N.; Pande, H. and Bisth, J. K. (2007). Bio-efficacy of herbicides in wheat under zero and conventional tillage systems. *Indian J. Weed Sci.,* **39**(3&4): 201-204.

Jat, R. S.; Nepalia, V. and Chaudhary, P. D. (2003). Influence of herbicides and method of sowing on weed dynamics in wheat. *Indian J. Weed Sci.,* **35**: 18-20.

Kumar, D.; Angiras, N. N.; Singh, Y. and Rana, S. S. (2005). Influence of integrated weed management practices on weed competition for nutrients in wheat. *Indian J. Agric. Res.,* **39**(2): 110-115.

Kumar, S. and Agarwal, A. (2011). Effect of different cultural and chemical weed management practices on weeds and wheat. *Proceedings of National Academy of Sciences, India Section B* **81:** 231-234.

Kumari, A.; Kumar, S.; Singh, B. And Dhaka, A. (2013). Evaluation of

herbicides alone and in combination for weed control in wheat. *Indian J. Weed Sci.,* **45**(3): 210-213.

Nanher, A. H.; Singh, R.; Yadav, S.; Tyagi, S.; Kumar, V.; Singh, A. K. and Shamim, S. A. (2015). Effect of metribuzin in combination with post emergence herbicide on weed and productivity of wheat. *An Int. Quarterly J. Life Sci.,* **10**(3): 1345-1348.

Paighan, V. B.; Gore, A. K. And Chavan, A. S. (2013). Effect of new herbicides on growth and yield of wheat. *Indian J. Weed Sci.,* **45**(4): 291-293.

Panse, V. G. and Sukhatme, P. V. (1985). *Statistical Method for Agricultural Workers*. ICAR Publication, New Delhi. pp. 87-89.

Pisal, R. R.; and Sagarka, B. K. (2013). Integrated weed management in wheat with new molecules. *Indian J. Weed Sci.,* **45**(1): 25-28.

Pradhan, A. C. and Chakraborti, P. (2010). Quality wheat Seed Production through integrated weed management. *Indian J. Weed Sci.,* **42**(3&4): 159-162.

Saquib, M.; Bhilare, R. L.; Singh, R.; Ansari, M. H.; Singh, M. P. and Kumar, A. (2014). Weed management in wheat (*Triticum aestivum* L.). *Plant Arch.,* **14**(1): 77-79.

Savary, S.; Willocquet, L.; Elazegui, F. A.; Castilla, N. P. and Teng, P. S. (2000). Rice pest constraints in tropical Asia: quantification of yield losses due to rice pests in a range of production situations. *Plant Disease J.,* **84**: 357-369.

Sharma, S.N. and Singh, R. K. (2011). Productivity and economics of wheat (*Triticumaestivum* L.) as influenced by weed management and seed rate. *Prog. Agric.,* **11**(2): 242-250.

Singh, A. P.; Pandagare, T.; Abraham, S.; Chandrakar, D. and Chowdhury, T. (2015). Evaluation of metribuzin in combination with clodinafop, sulfosulfuron and pinoxaden for weed control in wheat. *An Int. Quarterly J. Life Sci.,* **10**(1): 271-274.

Singh, B.; Dhaka, A. K.; Pannu, R. K. and Kumar, S. (2013). Integrated weed management-a strategy for sustainable wheat production-a review. *Agric. Reviews,* **34**(4): 243-255.

Tiwari, A.; Rai, O. P.; Singh, G.; Sharma, J. D.; Harikesh and Singh, V. (2017). Studies on effect of nitrogen and weed management on yield and economics of late sown wheat (*Triticum aestivum* L.). *J. Pharmacog. Phytochem.,* **6**(6): 379-383.

Tiwari, S. N.; Tewari, A. N. and Tripathi, A. K. (2005). Effect of herbicidal weed management on wheat productivity and weed growth. *Indian J. Agril. Sci.,* **75**(9): 569-567.

Verma, S. K.; Singh, R. P. and Kumar, S. (2017). Effects of irrigation and herbicides on the growth yield and yield attributes of wheat (*Triticum aestivum* L.). *Bangladesh J. Bot.,* **46**(3): 839-845.

Yadav, N. S. and Dixit, A. (2014). Bioefficacy of some herbicides and their mixtures against complex weed flora in wheat. *Indian J. Weed Sci.,* **2**:180-183.

Zand, E.; Baghestani, M. A. and Shimi, P. (2003). Weed control in wheat fields of iran. *Proceedings of the First International Congress of Wheat*, Tehran, Iran. pp.419-450.

Table1: Effect of integrated weed management on weed studies

Treatments	Population of Weed (m^{-2})				Dry Matter of Weeds (g m^{-2})				Weed Control Efficiency (%)				Weed Index (%)
	30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS	
T_1	21.43	34.70	41.77	48.27	45.30	109.47	167.33	193.73	0	0	0	0	45.24
T_2	3.60	9.50	17.97	21.73	5.96	20.00	31.90	47.27	86.82	81.01	80.92	75.57	0
T_3	23.20	30.33	37.83	44.30	42.04	84.50	140.00	171.73	7.21	16.64	16.25	11.23	33.72
T_4	21.03	31.77	39.63	47.17	44.33	97.83	161.27	186.77	2.10	3.98	3.53	3.46	38.61
T_5	19.10	19.33	27.33	30.73	44.78	38.57	60.97	90.73	1.15	63.93	63.63	53.09	9.39
T_6	21.10	26.07	33.10	39.17	44.19	68.17	106.43	139.97	2.45	36.62	36.33	27.65	21.42
T_7	21.00	21.30	29.97	33.10	43.77	49.63	77.33	108.10	3.38	53.95	53.74	44.13	13.81
T_8	19.77	29.07	34.80	42.00	44.48	74.30	122.40	154.10	1.81	27.12	26.78	20.35	25.54
T_9	21.60	23.33	31.67	36.00	40.75	59.60	91.53	125.49	9.98	45.49	45.24	35.14	18.79
T_{10}	3.53	12.43	20.93	24.80	5.47	23.60	40.63	62.37	87.93	75.79	75.69	67.77	2.68
T_{11}	4.13	15.53	23.90	27.85	6.81	29.70	45.43	71.23	84.97	72.95	72.82	63.18	4.54
CD (P=0.05)	2.74	3.10	3.94	4.73	3.31	4.01	4.83	4.81	7.37	4.92	3.08	2.36	4.59

Table 2: Effect of integrated weed management on crop studies

Treatments	Plant Height (cm)				Number of Tillers (m^{-2})				Leaf Area Index			
	30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS
T_1	10.10	36.28	73.07	76.00	96.17	224.33	275.33	270.00	0.59	2.95	2.99	2.89
T_2	15.07	45.10	90.53	93.58	128.33	314.67	439.67	431.33	0.78	4.10	4.58	4.26
T_3	10.07	38.05	77.41	80.75	94.33	240.33	314.67	308.67	0.63	3.17	3.35	3.21
T_4	11.13	37.02	74.70	77.46	97.00	233.33	295.33	287.67	0.60	3.08	3.12	3.11
T_5	11.17	43.15	85.59	88.28	94.67	297.67	420.67	410.00	0.60	3.89	4.32	3.94
T_6	10.27	39.98	81.45	84.43	95.67	257.33	358.00	347.00	0.59	3.39	3.78	3.46
T_7	11.78	42.05	84.21	87.55	99.07	283.33	395.33	388.33	0.57	3.78	4.18	3.79
T_8	11.25	39.05	79.02	81.85	98.33	247.00	329.67	324.00	0.62	3.25	3.59	3.30
T_9	10.78	40.96	82.30	85.28	97.30	271.67	370.67	359.67	0.60	3.52	3.97	3.58
T_{10}	15.43	44.82	88.83	92.19	125.33	311.33	436.00	427.67	0.76	4.05	4.47	4.20
T_{11}	14.67	43.97	87.49	90.35	123.33	307.00	435.67	423.33	0.75	3.98	4.46	4.15
CD (P=0.05)	1.48	1.63	3.20	3.73	3.86	4.74	4.1	4.32	0.08	0.14	0.13	0.12

Table 3: Effect of integrated weed management on yield attributes

Treatments	Dry Weight (g)				Spike Length (cm)	Grains / Spike	Test Weight (g)	Effective Tillers (m^{-2})	Grain Yield (q ha^{-1})	Biological Yield (q ha^{-1})	Straw Yield (q ha^{-1})	Harvest Index (%)
	30 DAS	60 DAS	90 DAS	120 DAS								
T_1	1.58	4.59	10.91	16.07	8.13	41.56	34.05	255.67	28.46	87.01	58.55	32.71
T_2	2.73	8.47	19.33	25.88	11.79	59.44	41.82	419.00	51.97	129.22	77.25	40.22
T_3	1.67	5.78	13.89	18.18	8.58	45.18	36.03	295.00	34.43	98.13	63.70	35.09
T_4	1.65	5.10	13.01	16.99	8.48	43.36	35.00	275.33	31.90	93.02	61.11	34.30
T_5	1.84	7.75	17.00	23.01	10.99	52.77	40.13	400.33	47.07	119.28	72.20	39.46
T_6	1.73	6.68	15.38	20.26	9.44	48.97	38.77	335.67	40.82	109.25	68.43	37.36
T_7	1.79	7.57	16.74	22.50	10.11	50.37	39.87	378.33	44.78	115.92	71.14	38.66
T_8	1.68	6.04	14.49	19.06	8.95	46.75	37.11	312.33	38.69	105.59	66.90	36.64
T_9	1.75	6.96	16.17	21.36	9.78	49.87	39.28	348.33	42.20	112.25	70.04	37.61
T_{10}	2.63	8.30	18.05	24.78	11.68	57.20	41.50	415.33	50.58	126.62	76.04	39.96
T_{11}	2.57	7.96	17.25	24.00	11.58	55.13	40.40	414.33	49.60	124.22	74.61	39.94
CD (P=0.05)	0.07	0.50	1.04	1.49	0.22	4.25	1.07	4.78	2.38	4.85	3.92	1.80

Table 4: Effect of integrated weed management on economics of crop

Treatments	Gross Returns (Rs. ha^{-1})	Total cost of Cultivation (Rs. ha^{-1})	Net Returns (Rs. ha^{-1})	B: C Ratio
T_1	55,183.23	20720.50	34,462.73	1.66
T_2	96,026.87	26320.50	69,706.37	2.65
T_3	65,623.77	23120.50	42,503.27	1.84
T_4	61,142.23	20833.00	40,309.23	1.93
T_5	87,340.60	23270.50	64,070.10	2.75
T_6	76,674.37	21170.50	55,503.87	2.62
T_7	83,478.20	21440.50	62,037.70	2.89
T_8	73,000.27	20923.50	52,076.77	2.49
T_9	79,154.30	20990.50	58,163.80	2.77
T_{10}	93,594.83	23570.50	70,024.33	2.97
T_{11}	91,799.50	23323.50	68,476.00	2.94

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