COMPARATIVE EFFICACY OF DIFFERENT WEED MANAGEMENT STRATEGIES AND THEIR EFFECT ON GROWTH AND YEILD OF WHEAT *(Triticum aestivum L.)*

REPORT

Submitted to

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INTRODUCTION

Wheat is one of the major crop of the world and has the prime position in the cereal crops. It belongs to the Graminae family. It is also known as the-King of Cereals because of its highest genetic yield potential.It is a rabi crop. It is a staple food for about 2 billion people of many countries in the world. The wheat comprises of 55% of the carbohydrates and food calories. It is rich in vitamin protein and carbohydrates so provides a balance diet to millions of people of the world. In India it holds the second position after the rice crop. It originates from Euphrates valley but today it is found everywhere worldwide. Botanists consider wheat kernels as type of fruit which is also known as Caryopsis. In 1753 Linnaeus firstly classified wheat in the year 1918. Sakamura reported chromosome number sets. On this basis wheat is categorized into 3 categories viz. Diploids (2n = 14), tetraploids (2n=28) and hexaploids (2n=42) chromosome

The wheat crop is mainly grown in the Northern States and Uttar Pradesh is at the top with Total production of 25.22 million tons and it is followed by Punjab with 15.78MT. but the productivity of wheat crop is highest in Punjab. Wheat is sown from the month of September to December in various states of India and harvesting is done from February to May. The winter temperature when the Sowing is to be done should range from 10 to 15 degree Celsius and at the time of harvesting it should be from 21 to 26 degree Celsius. Wheat is considered as a cash crop because gives very good yield. In India wheat is grown mainly in U P, Punjab, M P and Haryana. Productivity in India is increasing at a faster rate and is around 2872 kg/ hectare and this data is given by Indian Department of Agriculture in the year 2014- 2015. U P is top most contributor of wheat with total production of 25.22 million tonnes, Punjab has production of 15.78 million tonnes and Madhya Pradesh with 14.18 tonnes production. U P has highest area under wheat and is also highest producer of wheat but its productivity is still less than national average (2561 kg/ha). On the other hand, productivity of Punjab is much higher than U P which is (4491 kg/ha) which beats every state in India.

Weed infestation is very important factor responsible for low yield in wheat.Weeds cause approximately 70% reduction in yield in wheat crop. Weeds not only compete with main crop plants for water, space, nutrients and light but also release some allelochemicals which harm growth of main crop (Reddy, 2000). In India various methods are used to control weeds like physical, mechanical, cultural and chemical methods. Physical and mechanical methods involve hoeing and intercropping. While cultural methods involve practices like stale seedbed or crop rotation. And chemical methods involve use of herbicides (Ahmed and Shaikh, 2003). All the above given methods of weed control have their own advantage and disadvantage. In order to sustain global agriculture food production, the importance of protecting arable crops against negative yield effect from weeds is well recognized. Unavailability of manual labour in peak season and unfavorable weather do not permit timely control of weeds. Therefore, weed control by mechanical means alone is not feasible. Hand or manual weeding though very effective and commonly adopted in India is expensive, tedious, time consuming and many a times become uneconomic. Further, manual weeding is not feasible in all situations and had many problems with varying crops and soil types. Chemical weed control is an important alternative. Herbicide have shown to be beneficial and very effective means of controlling weeds in wheat because they are quite effective and efficient (Azad *et al.)*

Along with above given methods a new approach called as Integrated Weed Management (IWM) is also coming into use by farmers but has not spread widely. IWM is not just another choice for weed control, but rather it is a necessity. Often what drives producers to alter weed control practices is when current strategies are no longer effective, or a new weed enters a field and requires a change in plan. Weed management programs must focus on environmental safety and should be sustainable and should also benefit the farm management alone it results in environmental pollution as well as soil degradation as it involves excessive use of fertilizers.

Weed management practices must not only rely totally on mechanical or chemical mean. Weed management practices must not only rely totally on mechanical or chemical means. It should focus on curative approach along with preventive methods. Preventive methods are applied before sowing while on the other hand curative approach control.Crops which are planted as row crops has potential to affect weed control. Farmers in India are adopting chemical weed control method which are very effective, ideal and practical. There main disadvantage is that they cause environmental pollution as well as they make some weed species resistant (Hassan and (Marwat, 2001).

Farmer should follow integrated weed management as this method is very environment friendly and in this inorganic chemicals are used but in very low amount means optimum amount of chemicals are used along with cultural and mechanical methods to affect weed control. Farmers in India are adopting chemical weed control method which are very effective, ideal and practical.

Objectives of the study;

- Study of different weed management strategies of wheat.
- Comparative study of different weed management strategies on weed biomass.
- To determine the effect of different weed management strategies on growth characters of wheat
- To study the effect of different weed management practices on yield
- To find out best weed management practices for wheat

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Scope of the study

To Study and evaluate the different weed management strategies in wheat crop. To assess the effect of weeds on yield attributes and yield of wheat. To evaluate the best method of management of weeds because chemical control alone causes environmental pollution. Thus there is a need to find the alternative way which is less costly, less laborious, easy to use and environment safely.

Review of Literature

Effect of different weed management strategies on growth and yield of wheat.

Amare (2010) studied the effect of weeds on wheat and its yield in randomized complete block design with three replications. 12 weed management practices were done as treatments. In this experiment , highest grain yield was recorded in hand weeding + 15 cm row spacing followed by isoproturon at 1.50kg/ha. In these treatments N uptake was recorded. Uncontrolled method causes grain yield loss of 57.6% - 73.2%.

R.K Singh *et al*., (2009) conducted an experiment to find suitable herbicide used to control weed flora in wheat crop. Result of the above set up experiment was that use of post emergence herbicides like Metsulfuron and 2, 4-D@ 6gm and 500gm/ha at 30-35 DAS showed the maximum weed killing efficiency and weed control efficiency 38.1% and 78.3% respectively.

Safdar *et al*., (2009) worked on various weed management methods in University of Sargodha, Pakistan during winters. Daab practice (stale seed bed technique), manual hoeing and chemical method were followed along with different planting geometries like single row, double row and criss cross sowing. Conclusion of the experiment was that daab practice, hand weeding along with chemicals gave cost benefit ratio of 1.95, 1.14 and 2.50 respectively. Chemical method is more profitable while daab method can be considered as advantageous. But environmental concerns should also be taken into consideration.

Kells (1996) worked on effective weed management methods which are essential for winter wheat production. According to this experiment, weed control practices must be applied at 4 times during production season before planting, at planting, during spring and after harvest. Weeds also lead to yield loss as well as problems in harvesting. Therefore, to overcome this chemical and cultural methods must be combinely followed to overcome weed problems.

Riaz *et al., (2003)*, studied various weed control methods under different growing patterns. Conclusion of this experiment was that integrated weeding means chemical weeding at 2-3 leaf stage of weed with recommended dose of isoproturon gave outstanding yield results.

Chhokar e*t al*., worked on different strategies to control weeds in wheat. In wheat growing regions, weed infestation is one of the most important biotic constraint. According to this research herbicides must be used along with adjuvants and safeners to increase efficiency of herbicides. Knowledge of weed biology and nonchemical methods of weed control with chemical methods makes weed management effective and efficient.

Shah *et al*., (1986), worked together to find out efficient way of weed management in wheat. Experiment was conducted under different agro climatic conditions of Pakistan. It was conducted in RCBD with five replications. Many different herbicides were to control weeds in wheat. Result of this experiment was that post emergence application of Isoproturon 50 WP @ 1 kg a.i / ha works well and control weeds and gives best yield

Khalil *et al*., (2006-2007) worked to find out the efficacy of herbicides on yield and yield components of wheat. This experiment was comprised of six herbicides plus hand weeding and weedy check plots. Herbicidal treatments were post emergence application of Affinity 50 WDG @0.016, Buctril super @ 1.23, Puma super 75 EW @ 0.94, Topik 15 WP @0.04 etc. hand weeding was performed three times

in whole season. For effective weed control Affinity 50 WDG proved to be the best treatment with minimum weed density

Fahad *et al*., (2013) made a study to assess the comparative efficacy of different herbicides for weed management in wheat crop. This experiment was laid out in a RCBD design with five replications. Different herbicides were used to manage weeds. Post emergence application of herbicides like Aim 40 DF @ 0.02 kg/ha, Isoproturon 50 WP @ 1kg a.i per hectare, Puma Super 75 EW @0.75 kg, Topik 15 WP @ 0.04 kg and Buctril super 60 EC @ 0.45 kg. Hand weeding and weedy check was also included. Maximum weed efficacy was recorded for Isoproturon which was 84% whereas minimum value was for Aim which was 37%.

Chhokar *et al*., (2012) worked on different weed management strategies in wheat. Phalaris minor is most dominating weed in northern India. For controlling weeds in wheat different herbicides either as tank mixture if compatible, (sulfosulfuron + metsulfuron , mesosulfuron + iodosulfuron) or as sequential if not compatible (fenoxaprop or clodinafop or pinoxaden with metsulfuron or 2, 4-D are required. Greater focus was done on spray technology. Integration of knowledge of weed biology and non – chemical methods of weed control with chemical methods will help in increasing life of existing herbicides and make weed management cost – effective and efficient.

Riaz *et al*., (1987-1992) studied different weed control methods (chemical, mechanical, hand weeding and their integration) under various cropping patterns (wheat-fallow-wheat, wheat-corn-wheat, wheat-legume-wheat) were compared for their efficiency to control various weed species. Among different weed control methods integrated weeding means chemical weeding (recommended dose of Isoproturon) at 2-3 leaf stage of weeds with a hand weeding after 50 days of sowing. This was followed by mechanical weeding after 20 days of crop sowing with a fallow up hand weeding after 50 days. It was concluded that chemical weeding at 2-3 leaf stage + hand weeding at 50 DAS gives best results in important cropping patterns.

Yasin *et al*., (2010) conducted a study to investigate the efficacy of five herbicides on narrow leaved weeds and growth and yield of wheat. An experiment was conducted at Agronomic Research Farm, University of Agriculture Faisalabad. Experiment was laid out in RCBD with three replications. Treatments studied were Topaz-15 WG @ 45 g a.i. /ha, Topic-15 WG @ 37 g a.i. /ha, Puma Super-75 EW @ 45 g a.i. /ha, Gramicide-6.9 EW @ 85 g a.i, /ha, Chinlima-6.9 EW @ 85 g a.i. /ha. From all above Puma Super power gave best results as it gives less weed biomass, more no. of spike bearing tillers, more no. of grains per spike, 1000 grain weight and grain yield (4.20 t/ha).

Kaur *et al*., (2016-2017) conducted an experiment at Students Research Farm, Khalsa College Amritsar to study the effect of pre-emergence and post-emergence herbicides on wheat yield during 2016-2017. Experiment was laid out in randomized block design with eight treatments as weed free, weedy check, Pendimethalin @ 2.5l/ha, Pendimethalin @ 3.75l/ha, Clodinofop @ 400g/ha, Sulfosulfuron @ 32.5g/ha, Pinoxaden @ 1000ml/ha, Atlantis @ 400g/ha and replicated thrice. Result revealed that Pendimethalin @ 3.75l/ha was found effective to control weed population and produced higher no. of effective tillers, 1000 grain weight and enhance yield upto 43.1% over weedy check.

Omer (2004) conducted a study at H Research Station Experimental Farm, during 1999/2000 seasons. The trial was laid out in randomized block design with three replications and twelve treatments. The treatments comprised of various herbicides like pre-emergence application of pendimenthalin @ 1 kg ha^{-1} and post-emergence application of 2,4-D @ 0.5 kg ha^{-1}, metribuzin @ 0.3 kg ha^{-1} metsulfuron @ 0.02 kg ha^{-1}, pedimethalin + one hand weeding, pendimethalin + 2, 4-D, metribuzin + one hand weeding, metribuzin + 2, 4-D, pendimethalin + metsulfuron and metribuzin +

metsulfuron, compared with hand weeding performed at 25 and 45 days after sowing (DAS) and unweeded control.

The objectives of this research were to study the magnitude of yield loss due to weeds and to develop an integrated weed management strategy in wheat, based on both cultural and chemical methods. The study was comprised the following research activities: 1- Effect of wheat cultivars, seed rate and inter-row spacing with or without hand weeding in suppressing weeds associated with wheat crop. 2- Evaluation of the effect of the different population densities of S. arvensis on growth and yield of wheat. 3- Evaluation the efficacy and selectivity of the herbicides 2,4. D, Topik and Puma, alone or in tank mixtures for weed control in wheat. 4- Evaluation effect of time of application of 2,4. D on its activity on broad- leaved weeds and its selectivity on wheat crop. . Results showed that the herbicides2,4. D Topik and Puma alone or in tank- mixtures possess high selectivity for wheat crop. The herbicides Topik and Puma gave excellent and lasting control against grassy weeds but failed to control broad-leaf weeds.

Noori (2014-14) conducted an experiment at Agronomy Main Research Station of Orissa University of Agriculture and Technology, Bhubaneswar during winter season of 2013-14 to evolve an effective integrated weed management practice for wheat. The trial was laid out in RBD with three replications and twelve treatments. The treatments comprised of various herbicides like pre-emergence application of pendimenthalin @ 1 kg ha^{-1} and post-emergence application of 2,4-D @ 0.5 kg ha^{-1}, metribuzin @ 0.3 kg ha^{-1} metsulfuron @ 0.02 kg ha^{-1}, pedimethalin + one hand weeding, pendimethalin + 2, 4-D, metribuzin + one hand weeding, metribuzin + 2, 4-D, pendimethalin + metsulfuron and metribuzin + metsulfuron, compared with hand weeding performed at 25 and 45 days after sowing (DAS) and unweeded control. The treatment of pendimethalin + one hand weeding registered the maximum net profit of Rs 7195 ha^{-1} indicating the most cost effective integrated weed management practice for wheat

Singh *et al.*, (2002a) reported that weed infestation during the crop period causes more than 53 per cent reduction in grain yield, depending on the weed densities and type of weed flora present.

Singh *et al.*, (2002b) observed that *Phalaris minor* was controlled effectively by the application of clodinofop – propargyl @ 50 and 60 g/ha PoE. Isoproturon (500 and 750 g/ha) caused reduction in the density of *Chenopodium album* and *Melilotus alba.*

Singh *et al.*, (2002c) observed that weed control efficacy of sulfosulfuron was lower at 20 g/ha than at higher doses (25, 30 and 45 g/ha).

Singh and Kundra (2003) reported that sulfosulfuron and fenoxaprop provided effective control of *Phalaris minor* in wheat. Significantly increase in grain yield of wheat under sulfosulfuron over that under isoproturon was supported by more numbers of effective tillers and other yield contributing characters.

Tomar *et al.*, (2004) reported that all the weed management treatments decrease the dry matter production of weeds over the unweeded control. Application of isoguard 1 kg / ha gave the maximum yield (4348 kg/ ha.) and next best treatments were clodinofop 60 g / ha + metribuzin 150 g / ha (4298 kg/ ha), sulfosulfuron 25 g / ha (4167 kg / ha) and metribuzin 250 g / ha resulting in higher W.C.E.(87.8 - 94.3%).

Chhipa *et al.*, (2005) observed that the highest grain yield was obtained in the weed-free control (48.5 q/ha), then by metsulfuron-methyl (47.2 q/ha), metsulfuron-methyl (46.9 q/ha) and then hand weeding (44.1 q/ha)

Jat *et al.*, (2005) reported that significant higher yield can be obtained by metsulfuron-methyl at 4 g/ha and sulfosulfuron at 25 g/ha than the weedy check.

Kumar *et al.*, (2006) studied that clodinafop, fenoxaprop and sulfosulfuron sprayed at 250 or 500 litres/ ha provided 92-93, 83-84 and 89-91 per cent control of *Phalaris minor,* respectively. When clodinafop, fenoxaprop and sulfosulfuron were applied at lower rates, the weed control efficiency was reduced by 10, 18 and 9%, respectively.

Walia and Singh (2006) also recorded that 36% reduction in grain yield is due to unchecked growth of weeds. The grain yield was increased significantly due to different herbicidal treatments over weedy check and gave grain yield at par with weed free.

Bharat and Kachroo (2007) found that fenoxaprop + metribuzin (120 + 100 g ai/ ha.) either tank mix application of sulfosulfuron + 2,4-D (25+500 g ai/ ha.), clodinofop + metsulfuron (60 + 2 g ai/ ha.), isoproturon + 2,4-D (750 + 500 g ai/ ha.) or alone application of sulfosulfuron (25 g ai/ ha.), metribuzin (175 or 200 g ai/ ha.) and isoproturon (1000 g ai/ ha.) reduced the dry weight of weeds significantly then weedy check and other herbicidal treatments.

Gopinath *et al.*, (2007) reported that Metribuzin at 200 g/ha and sulfosulfuron at 33 g/ha being at par with each other recorded significantly lower weed dry weight compared to tank mix spray of isoproturon (750 g/ha) + 2, 4 –D (500 g/ha) and weedy check. The herbicide metribuzin at 250 g/ha recorded maximum net return and benefit cost ratio. Sulfosulfuron at 33 g/ha was the second best remunerative treatment.

Nariyal *et al.*, (2007) conducted a field trial during rabi season on wheat at G.B. Pant University of Agriculture & Technology, Pantnagar. *Phalaris minor, Chenopodium album, Medicago denticulata, Coronopus didymus, Melilotus indica* and *Rumex acetosella* were the major weed species in the experimental field. All the weed control treatments caused significant reduction in the density and dry weight of total weeds over weedy check at 60 days stage of crop growth. The lowest density and dry weight of weeds were recorded with sulfosulfuron at 25 g ai/ha + surfactant at 1250 ml/ha, which was followed by pinoxaden at 45 or 50 g ai/ha, application of pinaxaden 45 or 50 g ai/ha at 30 days after sowing was very effective for the control of *Phalaris minor*.

Verma *et al.*, (2007a) reported that application of sulfosulfuron reduced the uptake of nutrient by weeds and increased by crop which resulted in higher grain and straw yield and it was at par with fenoxaprop-p-ethyl and significantly superior over rest of the herbicidal treatments. Weed free treatment obtained significantly higher yield attributes, grain and straw yield and reduced the nutrient depletion by weeds over rest of the weed control treatments.

Verma *et al.*, (2007b) found that herbicides applied one week after 1st irrigation were more effective than before 1st irrigation. Sulfosulfuron 25 g/ha applied after 1st irrigation was most effective against the grassy and broad leaf weeds and had minimum NPK uptake by weeds. Isoproturon + 2, 4-D sodium salt (750 + 500 g/ha) was at par with metribuzin (210 g/ha), but both were significantly superior to weedy check in reducing weed growth and nutrient uptake by weeds. Sulfosulfuron had maximum number of earhead, grains/ earhead, 1000 grain weight, grain yield and nutrient uptake by crop.

Upasani *et al.*, (2008) proved that post emergence application of carfentrazone-ethyl (2 kg/ha) and sulfosulfuron (0.032 kg/ha) being at par significantly allowed lowest density of almost all weeds. Application of lower dose of carfentrazone-ethyl (1.75 kg/ha) and isoproturon (1.25 kg/ha) although had slightly higher density of weeds but dry matter was comparable with the above mentioned two herbicides. Weed free plots produced maximum grain yield of wheat which were comparable to the yield obtained with carfentrazone–ethyl (2.0 or 1.75 kg/ha). Sulfosulfuron (0.032 kg /ha) and isoproturon (1.25 kg /ha) mainly due to superiority of ear head /m2 and grains /ear head.

Yadav *et al.*, (2009a) conducted two field experiments to evaluate the efficacy of pinoxaden against *Phalaris minor* in wheat. Pinoxaden 10 EC 40 g/ha + adjuvant 2,000 ml/ha and pinoxaden 5 EC (with built-in adjuvant) 50 g/ha reduced the dry weight of *Phalaris minor* to the extent of 92–99 and 89–98%, respectively, and were at par with weed free checks during both the years. Consequently, Pinoxaden 5 EC 50 g/ha and Pinoxaden 10 EC 40 g/ha + adjuvant 2,000 ml/ha being at par with weed free checks produced grain yield of wheat in the range of 6.1–6.2 and 5.7–6.1 t/ha. Efficacy of pinoxaden 10 EC against *P. minor* increased by about 70% with addition of adjuvant indicating that adjuvant is must with this formulation. Pinoxaden 5 EC 50 g/ha was superior to lower doses of fenoxaprop and sulfosulfuron, however, it was at par with clodinafop during both the years. Both formulations of pinoxaden were ineffective against broad-leaved weeds. Maximum net returns (Rs 14,400-19,500/ha) and benefit: cost ratio (0.74–0.91) was obtained under pinoxaden 5 EC 50 g/ha. There was no phytotoxicity on wheat and no residual toxicity on the succeeding rice crop.

Yadav *et al.*, (2009b) studied the bioefficacy of ready mix formulation of clodinafop + metsulfuron against complex weed flora in wheat. The experimental site was dominated mainly by *Phalaris minor, Carnopus didymus, Anagallis arvensis, Melilotus indica, Medicago denticulata, Rumex retroflexus, Vicia sativa* and *Lathyrus aphaca*. Density and dry weight of *Phalaris minor* under ready mix formulation of clodinafop + metsulfuron 64 g/ha were at par with clodinafop alone 60 g/ha, sulfosulfuron 25 g/ha, clodinafop fb metsulfuron 60 and 4 g/ha, clodinafop + carfentrazone 60 + 20 g/ha and sulfosulfuron + metsulfuron redy mix 32g/ha during both the years. All the ready mix doses of clodinafop + metsulfuron provided good control of broad leaf weeds. Consequently, clodinafop + metsulfuron (ready mix) 64 g/ha produced grain yield similar to weed free check during both the years.

Materials and Methods

Location of the experiment
Experiment will be conducted at the field of Lovely Professional University, Phagwara situated geographically at 252 m above sea level. It falls under central plain zone of agro climatic zones of Punjab.

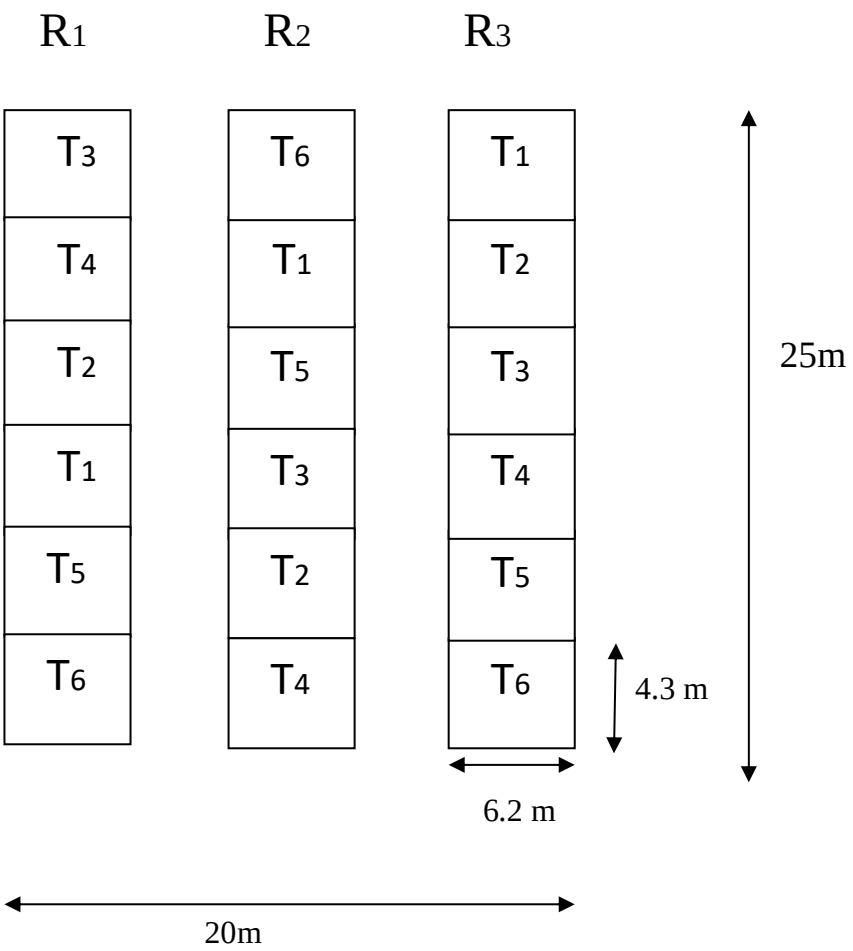
Brief introduction about work;

- **Crop**- Wheat (HD 3086)
- **Topic under discussion**- Comparative efficacy of different weed management strategies and their effect on growth and yield of wheat *(Triticum aestivum* L.)
- **Period of work**- 2017-18
- **Design of experiment**- CRBD
- **Sowing method**- Line sowing done.
- **Treatments**-

T1 - Control
T2 - Hand weeding (30, 60, 90 DAS)
T3 - Pendimethalin (Pre-emergence)
T4 - Metsulfuron Methyl (18 DAS)
T5 - Pendimethalin + Metsulfuron Methyl
T6 - metsulfuron + 1 hand weeding

Research Methodology

FIELD LAYOUT



Where,

R_1 = Replication 1

R_2 = Replication 2

R_3 = Replication 3

Treatment = 6

Replication = 3

No. of plots= 18

Observations recorded;

- **Growth and Yield parameters:**
  - Plant height (cm) { 30 , 60 , 90 DAS and at time of harvest }
  - Weed count {15, 30, 45, 60, 75, 90, 105 DAS and at harvest.}
  - Spike length
  - No. of spikelets per spike
  - No. of grains per spike
  - Yield per plot
  - 1000 grain weight
  - Dry matter production
  - Harvest index

- **Soil parameters:**
  - Soil PH
  - N, P and K content of soil
  - Organic carbon (%)
  - Organic matter (%)

Expected outcomes

The experiment will be conducted at the Lovely Professional University, School of Agriculture, near experimental farm of Phagwara, Punjab. By the use of different weed management approaches best method which will control weeds effectively and give good yield will be selected.

Harvesting

When leaves and stem turn yellow and become fairly dry – before it is dead ripe.

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