International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 3 March 2023, pp: 1281-1296 www.ijaem.net ISSN: 2395-5252

Effect of Pre and Post Emergence Weedicides on Weed Dynamics and Yield Parameters of Wheat (Triticum Aestivum L.)

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Date of Submission: 12-03-2023 Date of Acceptance: 22-03-2023

ABSTRACT

A fieldexperimentwasconducted atthe Research Farm of the Department of Agriculture,Maharishi Markandeshwar University, Sadopur, Ambala duringRabi season of 2020.Thepresentinvestigation entitled**"Effectof preandpost emergenceweedicidesonweeddynamics and yield parameters of wheat(Triticum aestivum L.)"**. The experimentwasarrangedinaRandomizedCompleteBlockdesign(RCBD)withseventreatmentsandeachtreatment was repeated three times. Different pre and post emergence herbicides such as **T1**: Weedycheck,**T2**:Pendimethalin (3000ml ha^{-1}),**T3**: Pendimethalin (2500ml/ha^{-1}),**T4**: 2,4D-AmineSalt(1000mlha^{-1}),**T5**:2,4D-AmineSalt(800mlha^{-1}),**T6**:Clodinofop(395gha^{-1}),**T7**:Clodinofop (360g ha^{-1}), **T8**: Meteribuzin (300g ha^{-1} + Hand hoeing), **T9**: Sulfosulfuron (34gha^{-1}) and **T10**: Sulfosulfuron (28g ha^{-1}+ Hand hoeing) were sprayed as post emergence herbicidesincluding weedy control. All herbicidal treatments significantly reduced weeds population but level ofefficacywasdifferentforeachherbicide.

I. INTRODUCTION

Wheat (Triticum aestivum L.) is considered as the most crucial among the different types ofcereal crops grown around the various states of India. It is widely grown in various parts ofthe world. Wheat is the most favoured staple food in human consumption among all the othergrain crops. Wheat is an annual, self pollinated crop belonging to Poaceae family. It is a Rabiseason crop. Wheat is a long day plant and requires a long exposure to lowtemperature. It requires rainfall between 30 to 100 cm and temperature varies from 15˚C - 20˚C.Itrequireswarmweatherandmoisture duringthelaterstages.

Wheat covers more of the earth's surface than any other cereal crop.it takes more land space than other cereals, it is only the third-largest cereal crop, behind maize and rice. The domestication of grains andthedevelopmentofagriculturallifestylesledtosignificantchangesinpeople'slives,encouragingpermanentsettlements,thedevelopmentofcivilization,andtrade.Wheat'sdomestication produced larger grains and a more productive crop, which could not havesurvivedinthewildandrequiredcontinuedinterventionoffarmers intentionallyplantingit.

As one of the first grains to be domesticated, modern wheat's developed from cultivationstarting in the Middle East about 9-11,000 years ago in the fertile crescent of the Middle East.Withoutaclearlyidentifiabletimeframe,theNeolithicperiodisidentifiedbythedomestication of crops and animals, which began with the development of farming, andendured until the development of metal tools. By 4,000 BC the expanding geographical rangeof farming resulted in bread wheat becoming a common staple from England to China.Although rice was more important to the development of East Asian cultures, wheat was thenutritional foundationforculturesinEurope,the MiddleEastand westernAsia.

Wheatwas introduced in Mexicoby the Spaniards around 1520 and toearly Americancolonists in the 1600's. At that time it was not popular in New England due to the soils andclimate,butinthemid1800'swheatwasgrownfrom seedsintroducedbymigratingEuropeansandagriculturalscientists intheareathatwouldlaterbecalledthe"WheatBelt."

The 1830's saw the development of the reaping and threshing machines, allowing farmers togreatly increase their productivity during harvest. The development of the steam engine in the1880's

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and the internal combustion engine in the 1920's increased farmer productivity duringbothplantingandharvest,andasa resultwheatfieldsbecamelarger.

Wheat is generally grown intended for food for humans, but lesser quality wheat and thenutrient-dense by-products of flour refining are used for animal feed. Wheat is also used forwhiskey and beer production, and the husk can be separated and ground into bran. Before theintroduction of corn into Europe, wheatwas the principal source of starch for sizing paperandcloth.Mostbreads,evenryeandoatbreads,are madewithatleastaportionofwheat flour because of two main quality characteristics of wheat that improve the breads - its gluten,and its alpha-amylase activity . High gluten flours offer elasticity in the dough, allowing for itto rise without developing large air pockets. Tender pastries, like pie crusts and biscuits, arebestwith lowglutenflours.All wheatfloursarebestwithlowalpha-amylaseactivity,because alpha amylase turns starch tosugar and prevents developmentof proper doughcharacteristics. Many flours are carefully blended mixtures of both hard and soft wheat'sdesigned precisely fora specific purpose.Wheatcultivarscan be classifiedby plantingseason, hardness of the grain, and (less importantly) color. Winter wheat is winter hardy, sothey are plantedin thefall. In the spring they resumematuration and areharvested earlyinthesummer. Spring wheat'sareplantedin thespringandharvestedlatein thesummer.Spring wheat yields are significantly lower than winter wheat yields, but it offers a very highquality for bread making. Soft wheat varieties have starchy kernels (less gluten) which milleasier than the hard wheat's. Soft wheat flour is preferred for piecrust, French bread, biscuits,and breakfastfoods. Hard wheat's have higher protein and gluten levels than their softercousins, and are used for bread, cakes and flour. The hardest wheat is durum (T. durum),whose flour is used in the manufacture of macaroni, spaghetti, and other pasta products. Softwheat's and white wheat's usually bring higherpricesbecause they are easier to mill anddon't require bleaching .Weeds are unwanted plants in the cultivated field.Weeds cause hugeloss to the agricultural production because of their vying nature with crop for nutrition andother important factors such as light, moisture and space. Weeds hampers seed cleaning,obstruct waterways, increased risk of fire and thus, elevates the cost of production (Ashrafi etal.,2009).

Weeds are the agent that causes more damage to the main crop as compared to insects, fungiand other pests . Loss of crop yield may occur due to the type anddensity of weed. The weeds can be controlled through cultural, mechanical, physical andchemical methods. The weed control method which is commonly used in India is manualweeding but it is expensive, time consuming and does not have that much profit. Also,performing manual weeding is not preferrable in all conditions and causes many hurdles ingrowth of differentcrops andsoils.Therefore,chemical control methodcanbeagoodalternative to control weeds. Herbicide is a chemical which is used to kill or inhibitthegrowth of unwanted plants. Herbicides applied at the right time and in the right dose haveproven profitable yields in wheat crop. The continuous use of herbicides in wheat causesresistance to the herbicides in Phalaris minor. There is a need to develop integrated methodsusing herbicides with manual methods. Therefore, the present investigation entitled 'Effect ofpreandpostemergenceweedicidesonweeddynamic sandyieldparametersofwheat(Triticum aestivumL.)'isconceptualizedwithfollowingobjectiv es:

II. MATERIALS AND METHODS

The present investigation entitled, **"Effect of pre and post emergence weedicides on weeddynamics and yield parameters of wheat''** was carried out during Rabi 2020-2021 at theResearchFieldofDepartmentofAgricultureatMah arishiMarkandeshwarUniversity,Sadopur, Ambala (Haryana). The experiment was conducted under randomized block design(RBD) and replicated thrice, during Nov – April (2020-2021). The details of the materialsusedandthemethodsadopted duringthecourseoftheinvestigationaregiveninthischa pter.

2.1 Experimentalsite

The experimental site is located at 30º42'39" N latitude and 76º77'69" E longitude and at an altitude of 264 m above mean sea level. The area represents the tropical an semi-arid climate.

2.1.2 Agro-Meteorologicalfeatures

Climate of the location is as tropical and semi-arid with hotand dry summer(ApriltoJune),hotandhumidmonsoonperiod(JulytoSeptember)andcoldwinter(December to February). The mean maximum and minimum temperature shows considerablevariations throughout the year. The maximum temperature reaches near 40ºC during summerand minimum temperature decreases below 4ºC during the winter months of December andJanuary. The average temperature is about 23.6º C. The average annual rainfall of region isabout 74.8 cm per year. Photoperiodically, wheat is a long-day plant which needs optimumtemperature rangefor ideal germinationof wheat seedis20-25ºCthoughtheseedscangerminate in the temperature range 3.5 to 35 º C. Rains just after sowing hamper germinationandencourageseedlingblight.Areaswith awarmanddampclimatearenotsuitedforwheatgrowin g..Itisgrowninregionswithannualrainfallfrom60-110cm.

2.1.3 Soilanalysis
Soilsampleswerecollectedbeforethelayoutoftheexperimentandaftertheharvestingofcrop atdepthof0-15cm.

Table3.1Physical-chemicalpropertiesofsoil (pre-sowing)

Particular	Value
SoilpH	8.64
SoilEC(dsm^{-1})	0.34
Soilorganiccarbon(%)	0.75
Bulkdensity(g/cm^{3})	1.31
Particledensity(g/cm^{3})	2.43
Porosity(%)	46.09
AvailableN(kgha^{-1})	310.50
AvailableP(kgha^{-1})	12.77
AvailableK(kgha^{-1})	137.45

2.2 ExperimentalDetails
Experimentaldesign Randomizedblockdesign
Crop Wheat
Variety HD-3086
Replications 3
No.oftreatments 10
No.ofplots 30
Size ofplot 2×3m^{2}
Spacing 22.5cm
Widthofmain irrigationchannel 60cm

Treatments:
T1:Weedycheck
T 2: Pendimethalin (3000 ml/ha)T 3: Pendimethalin (2500ml/ha)T 4: 2,4D-Amine Salt (100ml/ha)T 5:2,4D-Amine Salt (800ml/ha)T6:Clodinofop(395g/ha)
T 7:Clodinofop(360g/ha)
T 8:meteribuzin(300g/ha +Handhoeing)T9:Sulfosulfuron(34g/ha)
T10:Sulfosulfuron(28g/ha+Handhoeing)

2.2 Culturaloperations
2.2.1 Fieldpreparation
Before sowing the soil was prepared for seed bed conditions by two dry ploughing followedby harrowing, leveling and ridges formation. The field was divided into three blocks alongwith the two irrigation channels, one at the front of the first block and other was between thesecond and third block. Each block was further divided into ten different plots; the size ofeachplotwas2x3m.ThebasicNPKfertilizerdose100-60-40kg/hawasappliedasdiammoniumphosphate (DAP)andurea,aweekbefore sowing.

2.2.2Sowing
Line sowing method was adopted for sowing wheat because thismethod is considered bestfor cultivation during monsoon and winter seasons both under excess and limited wateravailability conditions. The advantage of line sowing seeding is that it permits large acreagesto be sown in less time; the disadvantages are poor soil to seed contact, uneven plantingdepths (some seed too shallow for proper emergence of permanent root systems and otherseed toodeepforgermination),and,often,poorplantdistribution.

2.2.3Manureandfertilizerapplication
The doses of nitrogen, phosphorus, potassium and zinc sulphate were applied during thecourseofexperimentaccordingtothetreatments.Halfthenitrogenandtheentiredoseof phosphorus, potassium were applied as a basal dose at the time of sowing and rest of nitrogenwastop

dressedintwosplitdoseson25 daysaftersowing and 45 daysaftersowing.

2.2.4 Irrigation

The crop was irrigated at interval of 20-25 days after sowing or at the critical stages toprevent the crop from an any kind of water stress. The following irrigations were givenaccording to the needs of the crop. Thus four irrigations were applied during the cropseason.

2.2.5 Herbicidesapplication

All the herbicides were applied as pre-emergence at 2 DAS and post-emergence with the useof manually operated knapsack sprayer joined with flat fan. Different herbicides have beenused in different quantities which were as follows T1 weedy check, T2 Pendimethalin (3000ml/ha^{-1}), T3 Pendimethalin (2500 ml/ha), T4 2,4D-Amine Salt (100ml/ha), T52,4D-AmineSalt(800ml/ha),T6clodinofop(395g/ha),T7Clodinofop(360g/ha^{-1}),T8Meteribuzin(300g/ha + Hand hoeing), T9Sulfosulfuron (34g/ha) and T10Sulfosulfuron (28g/ha +Handhoeing).

2.2.6 Handweeding

Weeds were removed manually in two hand weeding at 30 and 50 DAS in weed withtreatmentduringthecroplifecycle.

2.2.7 Harvestingandthreshing

Grains were harvested when grains were fully developed and having 15 percent moisture in grain . The harvesting of crops was done on 11th of April.The harvested plants were bundled, sun-dried and weighted before threshing to record total(grain+straw)yield.Threshingwascarriedoutand grainspernetplotcollectedwerewinnowed,cleanedandweighed.

2.4 Datesofagronomicoperations

The crop was raised following all recommended package and practices for wheat, exceptvariabletreatments.Thedatesofvariousoperationsfollowedduringtheperiodofexperimentationhave beenpresentedinTable3.1

Table3.2Schedule ofvariousfieldoperationsperformedduringRabi2020

S.No.	Operation	Date	Methodused
1	Pre-sowingirrigation	21.10.2020	Tubewell
2	Ploughing	30.10.2020	Tractorwithharrow
3	Ploughingandplanking	31.10.2020	Manual
4	Fieldlayout	01.11.2020	Manual
3	Basalapplicationoffertilizer	06.11.2020	Manual
4	Sowing	07.11.2020	Manual
5	Topdressingofnitrogen		Manual
	1st topdressing(30daysaftersowing)	06.12.2020	
	2nd topdressing(45days aftersowing)	21.12.2020	
6	Herbicidesapplication		Manualwithspray

1st preemergence(2daysaftersowing)	09.11.2020	
2nd postemergence(32daysaftersowing)	09.12.2020	
3rd postemergence(42daysaftersowing)	21.12.2020	
4th postemergence(43daysaftersowing)	22.12.2020	
5th postemergence(44daysaftersowing)	23.12.2020	
7 Irrigation		Manual
1st Irrigation (22daysaftersowing)	29.11.2020	
2nd Irrigation (41daysaftersowing)	20.12.2020	
3rd Irrigation (73daysaftersowing)	19.01.2021	
4th Irrigation (92daysaftersowing)	07.02.2021	
8 Harvesting	12.04.2021	Manual
9 Threshing	18.04.2021	Manual

2.5 Observations
The response of wheat crop to various treatments application under the present investigationwasanalyzedonthebasisofweed studies,growth,yields,andnutrientuptakeinwheat.

2.5 .1 Studiesonweeds
2.5 .2Weeddensity
Weed density was recorded using a quadrate of 50 cm (0.25 m^2) size randomly. Weed countspecies wise was taken is at 30, 60, 90 DAS and at harvest stage of crop growth and reportedasnumberofweedm^2.

2.5.3Weedcontrolefficiency
Weed controlefficiencywasworkedoutat60 and90 DASstageonthe basisofreductionindry weight of weeds in the treated plot in dry weight of weeds under weedy check (control)usingfollowingformula:

$$WCE=\frac{DWC-DWT}{DWC}\times 100$$

Where,

WCE=WeedcontrolefficiencyDWT= Dryweight ofweedsintreated plot.

DWC=Dryweightofweedsinweedycheck(control)plot.

2.5.3 Studiesonwheat
2.5.3.1 Growthparameters
2.5.3.2Plant height(cm)
The height was measured from five tagged plants from the base of the plant to the highestterminal point by a meter. Average of five plants were taken to compute mean plant height at30,60,90DASandatharvest.

2.5.4 NumberofTillers
Thenumberoftillers inwheatplantweremeasuredusingascale.

2.6 Yieldattributesandyield
2.6.1Numberofspike
Number of spike was recorded by using a quadrate of one square meter in each plot as perprocedurefollowedforcountingnumberofspike atharveststage.

2.6.2 **Lengthofspike**
The average spike length was measured by taking length (cm) of ten randomly selectedspikes.Thelengthofearmeasuredfromthebase ofthespike totopofthe lastspikelet.

2.6.1**Numberofgrainsperspike**
The number of grains from ten spikes from each plot which were selected for length of spikeas

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mentioned above was recorded and later on average number of grains spike was workedout.

3.6.3**Testweight(g)**

From bulkproduce of each netplot,a representativegrain samplewas drawn andonethousandseedswerecounted randomly.Theirweightwasrecorded as1000seed weight.

2.6.4**Biologicalyield(qha^{-1})**

After harvesting, the wheatcrop was sun driedup tofive days and then weight of netharvestedarea ofwheatineachplotwas recordedandconvertedintoqha^{-1}.

2.6.5 **Grainyield(qha^{-1})**

The produce of each net plot was threshed and collected separately and grain yield wasrecorded.The grainyield pernetplotwasthenconvertedintohectarebasis.

2.6.6 **Strawyield(qha^{-1})**

The straw yield was recorded by subtracting the grain yield from total yield of each net plotandsubsequentlythevalues wereconvertedonhectarebasis.

2.6.7 **HarvestIndex**

Harvestindex was calculated from economic yield (grain) and biological yield (grain +straw)byusingthefollowingformulagiven.

$$HI = \frac{\text{Grainyield}(qha^{-1})}{\text{Totalbiologicalyield}(qha^{-1})} X100$$

2.6.8 CollectionofSoil

Samples for identification of soil fertility constraints in the study area soil samples (surfaceandsubsurface)werecollectedunderdifferent treatmentsinthe studyarea.

2.7.1 Preparationandstoringofsoilsamples

Collected sol samples were dried in shade. The air dried samples were grinded with a woodenpestle and mortar and passed through 2 mm sieve to separate the coarse fragments (>2 mm).Thefineearthsampleswerestoredinseparatecontainersand usedfor variousanalyses.

2.7.2 Methodofsoilanalysis

3.7.3Soilreaction

SoilpHwasdeterminedin1:2soil-watersuspensionsbyglasselectrodepHmetermethod **(Jackson,1973).**

2.7.4 Electricalconductivity

Electrical conductivity was determined in 1:2 soil-water extract using Conductivity Bridgeandexpressedas dSm^{-1}(Jackson,1973).

2.7.5 Organiccarbon

The organic carbon content of a finely ground soil sample was determined by Walkely andBlack'swetoxidationthemethodasdescribedbyJackson(1973)andexpressedingkg^{-1}soil.

3.7.6 Particlesizeanalysis

Therelativeproportionofsand,siltandclayinsoilsamplewasdeterminedby usingBouyoucos hydrometer method as describing by **Bouzoucos, (1962)** using hydrogen peroxide(30%)tooxidationoforganicmatter.Thismethodmeasurestheviscosityofsoilsuspensionatthesurfaceatdifferenttime.

2.8.1 Economics

2.8.2Costofcultivation

Cost of cultivation of wheat crop was calculated per hectare on thebasis of local marketprice ofdifferentinputs usedincultivation.

2.8.3 Grossreturns(Rs.ha^{-1})

The monetary value of grain and straw yield was computed in rupees by using local marketpriceofoutputs.Grossreturnwasobtainedbyaddingmonetaryvalue ofgrainsandstraw.

Grossreturn(kgha^{-1})=Yield (kg) x Market price of crop (Rs. / kg)

2.8.4 **Netreturns(Rs.ha^{-1})**

Netreturnforeachtreatmentcombinationwascalculatedbydeductingthecostcultivationfromtherespectivegross return.

Netreturn(Rs.ha^{-1})=Grossreturn-ofcultivation

2.8.5 Benefit:costratio

Benefit:costratio, netreturnperrupeeinvested,wascalculatedusingthefollowingformula:

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$$B:C ratio = \frac{Net\ return(Rs.ha^{-1})}{Cost of cultivation(Rs.ha^{-1})}$$

2.8.6 StatisticalAnalysis

The data recorded during the course of investigation was subjected to statistical analysisusinganalysisofvariancetechnique(ANOVA)forsplitplotdesign.Standarderrorofmeanin each ease and critical difference only for significant cases were calculated at 5% levels ofprobabilityas under.

2.8.7 Standarderrorofmean

Standarderrorofmeanwillbecalculatedasfollows:

$$Standarderrorofmean = \sqrt{\frac{EMS}{R}}$$

Where,

SEm±=Standard error of mean
EMS = Error mean sum of square
R=Numberofreplicationonwhichtheobservationis based.

2.8.8 CriticalDifference

The data obtained was subjected to statistical analysis as outlined by **Gomez and Gomez(1984)**.The critical difference at 5% level of significance was estimated to compare treatmentmeanswherever'F'restwassignificant

$$CD(p=0.05) = \sqrt{\frac{2 \times Errormeansqugre}{r}} \times t(aterrord.f.)$$

CD=Criticaldifference
R=Numberofreplicationsofthefactorforwhich C.D.istobecalculated.
t0.05=valueofpercentagepointof'f'distributionforerrordegreeoffreedomat5percentlevelofsignificance.

III. CHAPTER-4 RESULTS AND DISCUSSION

The present investigation entitled **"Effect of pre and post emergence weedicides on weeddynamicsandyieldparametersofwheat''**was carriedoutduringRabi(2020)attheResearch Field of Department of Agriculture at Maharishi Markandeshwar University, Sadopur(Haryana). The results obtained from the present investigation are described and discussed underthefollowingheadings:

3.1EFFECTOFPREEMERGENCEANDPOSTAPPLICA TIONONWEEDCONTROL EMERGENCE HERBICIDE
3.2EFFECTOFPREEMERGENCEANDPOSTAPPLICATIONONGROWTHPARAMETERS EMERGENCE HERBICIDE
3.3EFFECTOF PRE EMERGENCE AND POST EMERGENCE HERBICIDE APPLICATIONONYIELDANDYIELDATTRIBUTES
3.4 EFFECTOFPREEMERGENCEANDPOSTEMERGENCEHERBICIDEAPPLICATIO NONQUALITYPARAMETERS
3.5EFFECTOFPREEMERGENCEANDPOSTEMERGENCEHERBICIDEAPPLICA TIONONECONOMICS

3.1.1 Plantheight

Themeanplantheightrecordedat30,60,90daysaftersowingandatharvestwassignificantly affected by different treatments and is presented in Table 4.1. The data showedthat plant height significantly increased with application of T_8: Meteribuzin (300 g/ha +Hand hoeing). At 30 days after sowing, the maximum plant height of 18.32 cm was recordedin the treatment T_8: Meteribuzin (300 g/ha + Hand hoeing) and it was significantly higherthan the other treatments. The minimum plant height of 12.73 cm was recorded in the T_1:Weedycheck.

\Table4.1. Effect ofpreandpostemergenceweedicidesonplantheightofwheat(TriticumaestivumL.)

Treatments	30DAS	60DAS	90DAS	AT HARVEST
T_1:Weedycheck	12.73	33.83	65.22	79.84
	14.21	34.73	69.09	80.34

T_2:Pendimethalin(3000ml/ha)				
T_3:Pendimethalin(2500ml/ha)	15.33	41.31	73.73	83.65
T_4:2,4 D-AmineSalt(1000ml /ha)	15.74	42.94	74.52	84.11
T_5:2,4 D-AmineSalt(800ml/ha)	14.32	40.90	73.31	83.84
T_6:Clodinofop(395 g/ha)	16.31	43.81	76.51	85.94
T_7:Clodinofop(360g/ha)	17.21	44.63	75.24	88.83
T_8:Meteribuzin(300 g /ha +Hand hoeing)	18.32	46.35	80.56	91.41
T_9:Sulfosulfuron(34g/ha)	16.74	41.92	75.72	84.86
T_{10}: Sulfosulfuron(28g/ ha + Hand hoeing)	17.97	45.85	78.25	89.43
SEm±	0.015	0..89	0.014	0.213
C.D.(P= 0.05)	0.044	0.265	0.041	0.638
CV(%)	0.164	0.362	0.03	0.415

3.1.2NumberofTillers

Themaximumnumberoftillersat30DASand60DASwereobservedinthetreatmentT_8:meteribuzin(300g/ ha+Handhoeing)whereasthelowestnumberoftillerswereobserved in the treatmentT_1:Weedycheck.

Table 4.2. Effect of pre and post emergence weedicides on tillers of wheat (TriticumaestivumL.)

Treatments	**30DAS**	**90DAS**
T_1:Weedycheck	2.0	4.1
T_2:Pendimethalin(3000ml/ha)	2.1	4.2
T_3:Pendimethalin(2500ml/ha)	2.3	4.7
T_4:2,4D-AmineSalt(1000ml/ha)	2.1	4.4
T_5:2,4D-AmineSalt(800ml/ha)	2.4	4.3
T_6:Clodinofop(395g/ha)	2.6	4.5

T_7:Clodinofop(360g/ha)	2.5	4.7
T_8:meteribuzin(300g/ ha+Hand hoeing)	2.8	5.3
T_9:Sulfosulfuron(34g/ha)	2.5	4.2
T_{10}:Sulfosulfuron(28g/ ha+ Hand hoeing)	2.7	4.9
SEm±	0.5	0.06
C.D.(P= 0.05)	0.15	0.17
CV(%)	4.2	2.4

3.1.3 Grains/spike

Acriticalstudyofthedatarevealedthatthemaximumgrains/spike(42)wasrecordedinT_8:meteribuzin (300g ha $^{-1}$ + Hand hoeing) which was found at par with T_{10}: Sulfosulfuron(28g ha $^{-1}$ + Hand hoeing). However, all the other treatments resulted in relatively highergrains/spikethantheweedycheck.

Table 4.3. Effect of pre and post emergence weedicides on test weight, grains/spike andspikelengthofwheat(TriticumaestivumL.)

Treatments	Grains/spike	Spike length(cm)	Testweight(g)
T_1:Weedycheck	35	6.8	35.2
T_2:Pendimethalin(3000ml/ha)	37	7.3	37.7
T_3:Pendimethalin(2500ml/ha)	38	7.5	38.9
T_4:2,4D-AmineSalt(1000ml/ha)	39	7.7	39.5
T_5:2,4D-AmineSalt(800ml/ha)	39	7.6	38.6
T_6:Clodinofop(395g/ha)	40	7.8	40.8
T_7:Clodinofop(360g/ha)	41	7.9	41.4
T_8:Meteribuzin(300g/ha +Handhoeing)	42	8.2	42.3

T_9:Sulfosulfuron(34g/ha)	40	8.0	38.1
T_{10}:Sulfosulfuron(28g/ha +Handhoeing)	41	8.1	41.5
SEm±	0.25	0.17	0.57
C.D.(P= 0.05)	0.67	0.50	1.74
CV(%)	0.95	0.32	2.04

3.1.9Spike length

The data on spike length is presented in Table 4.3 revealed that maximum spike length (8.2cm)recordedwithtreatmentT_8:meteribuzin(300g ha^{-1}+Handhoeing),whichwasfound at par with T_{10}: Sulfosulfuron (28g ha $^{-1}$ + Hand hoeing) and significantly superior to therest ofthetreatments.Minimumspikelength(6.8cm)wasshown byweedychecktreatment.

3.1.2Testweight

A criticalstudyofthedatarevealedthatthemaximumtest weight(42.3g)wasrecordedinT_8: meteribuzin (300g ha $^{-1}$ + Hand hoeing) which was found at par with T_{10}: Sulfosulfuron(28gha^{-1}+Handhoeing).However,alltheothertreatmentsresultedinrelativelyhighertestweightthantheweedycheck.

3.1.3WeedDensity:-

The highest weed density at tillering, ear head emergence and dough stage of wheat (Triticumaestivum L.) was observed in the treatment T_1: Weedy check, whereas the minimum weeddensitywasobservedinthetreatmentT_8:Meteribuzin(300gha^{-1}+Handhoeing).

Table 4.4. Effect of pre and post emergence weedicides on weed density (m^{-2}) at tillering,earheademergenceanddoughstage ofwheat(TriticumaestivumL.)

TREATMENTS	AtTillering(m^{-2})	AtEarhead(m^{-2})	AtDough(m^{-2})
T_1:Weedycheck	5.89	8.75	10.76
T_2:Pendimethalin(3000ml/ha)	3.62	6.13	7.32
T_3:Pendimethalin(2500ml/ha)	4.74	6.26	8.26
T_4:2,4D-AmineSalt(1000ml/ha)	5.24	7.12	7.23
T_5:2,4D-AmineSalt(8+00ml/ha)	4.99	6.58	4.89
T_6:Clodinofop(395g/ ha)	5.13	6.21	5.32
T_7:Clodinofop(360g /ha)	5.71	7.18	8.40

T8:Meteribuzin(300g/ha+Handhoeing)	3.06	3.35	4.33
T9:Sulfosulfuron(34g/ha)	4.03	6.37	7.13
T10:Sulfosulfuron(28g/ha+Handhoeing)	3.71	7.16	6.32
SEm±	0.17	0.04	0.43
C.D.(P= 0.05)	0.35	0.03	1.25
CV (%)	4.07	0.24	8.20

3.1.4 Weeddry weight

The highest weed dry weight at tillering, ear head emergence and dough stage of wheat(TriticumaestivumL.)wasobservedinthetreatmentT1:Weedycheck,whereastheminimum weed dry weight was observed in the treatment T8: Meteribuzin (300 g ha $^{-1}$ +Handhoeing).

Table 4.6. Effect of pre and post emergence weedicides on weed dry weight (g m^{-2}) attillering,earheademergence anddoughstageofwheat(TriticumaestivumL.)

Treatments	**At Tillers(gm^{-2})**	**AtEarhead(g m^{-2})**	**AtDough (g m^{-2})**
T1:Weedycheck	7.36	17.02	24.78
T 2:Pendimethalin(3000mlha^{-1})	6.33	14.89	22.88
T3:Pendimethalin(2500mlha^{-1})	5.90	14.25	22.51
T 4:2,4D-AmineSalt(1000mlha^{-1})	5.44	14.11	21.84
T 5:2,4D-AmineSalt(800mlha^{-1})	5.61	12.98	21.60
T6:Clodinofop(395g ha^{-1})	5.01	12.98	20.98
T7:Clodinofop(360g ha^{-1})	3.93	11.17	17.62
T8:Meteribuzin(300gha^{-1}+Handhoeing)	1.63	7.94	14.21
T9:Sulfosulfuron(34gha^{-1})	6.01	14.56	21.09
T10:Sulfosulfuron(28gha^{-1} +Handhoeing)	2.53	8.48	15.47

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SEm±	0.005	0.02	0.005
C.D.(P= 0.05)	0.016	0.06	0.01
CV (%)	0.181	0.02	0.04

3.1.5 Weedcontrolefficiency(%)

The treatment T8: Meteribuzin (300 g ha $^{-1}$ + Hand hoeing) resulted in the highest weedcontrol efficiency and the lowest weed control efficiency was given by the treatment T1:Weedycheck.

Table4.7. Effect ofpreandpost emergenceweedicidesonweedcontrolefficiency(%)ofwheat(TriticumaestivumL.)

Treatments	At tilleringstage (%)	At earheadstage (%)	At doughstage (%)
T1:Weedycheck	-	-	-
T 2:Pendimethalin(3000mlha^{-1})	12.02	8.02	6.47
T 3:Pendimethalin(2500mlha^{-1})	14.59	12.58	8.47
T 4:2,4D-AmineSalt(1000mlha^{-1})	28.72	17.87	13.03
T 5:2,4D-AmineSalt(800mlha^{-1})	20.72	16.02	10.12
T6:Clodinofop(395gha^{-1})	33.72	24.96	19.57
T7:Clodinofop(360g ha^{-1})	48.97	35.66	30.25
T8:Meteribuzin(300gha^{-1}+Handhoeing)	78.40	54.23	44.02
T9:Sulfosulfuron(34gha^{-1})	14.59	21.09	23.07
T10:Sulfosulfuron (28gha^{-1}+Handhoeing)	67.99	52.00	39.01
SEm±	1.08	1.19	1.32
C.D.(P= 0.05)	2.99	3.57	3.74
CV (%)	11.32	13.47	9.73

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 3 March 2023, pp: 1281-1296 www.ijaem.net ISSN: 2395-5252

3.1.6 Grainyield (q/ha)

From the data in table 4.5, it is clear that the maximum grain yield (56.35 q/ha) was recordedinT8:Meteribuzin(300gha^{-1}+Handhoeing)anditwasatparwithT10:Sulfosulfuron (28gha^{-1}+Handhoeing).Theminimumgrainyieldwas recordedinweedycheck.

3.1.7 Stoveryield(q/ha)

Thedataonstoveryieldinfluencedsignificantlybyvarioustreatmentsispresentedin Table4.5. The data indicated that T8: Meteribuzin (300 g ha^{-1} + Hand hoeing) gave the higheststover yield (71.28 q) which was found at par with T10: Sulfosulfuron (28 g ha^{-1} + Handhoeing).Overalltheweedycheckgave thelowest stoveryield(54.65q).

3.1.8 Biologicalyield(kg/ha)

The data in table 4.5, indicated that T 8: Meteribuzin (300 g ha^{-1} + Hand hoeing) gave thehighest biological yield (127.63 q) which was at par with T10: Sulfosulfuron (28 g ha^{-1} +Handhoeing).Whereas,theweedycheckgavethelowestbiologicalyield (92.77q).

3.1.9 HarvestIndex(%)

The data showing the effect of different treatments on harvest index is presented in Table 4.5.The data in table 4.5, indicated that T8: Meteribuzin (300 g ha^{-1} + Hand hoeing) gave thehighest harvest index (44.15%) which was at par with T10: Sulfosulfuron (28 g ha^{-1} + Handhoeing).Whereas,theweedycheckgavethe lowestharvestindex(41.09%).

Table 4.5. Effect of pre and post emergence weedicides on yield of wheat (TriticumaestivumL.)

Treatments	Grainyield (q/ha)	Strawyield(q/ha)	Biologicalyield(q/ha)	Harvestindex(%)
T1:Weedycheck	38.12	54.65	92.77	41.09
T 2:Pendimethalin(3000mlha^{-1})	42.34	54.17	96.51	43.87
T 3:Pendimethalin(2500mlha^{-1})	50.76	64.09	114.85	44.19
T 4:2,4D-AmineSalt(100mlha^{-1})	51.03	64.08	115.11	44.33
T5:2,4D-AmineSalt(800mlha^{-1})	40.95	54.02	94.97	43.11
T6:Clodinofop(395g ha^{-1})	52.23	66.22	118.45	44.09
T7:Clodinofop(360g ha^{-1})	52.01	65.03	117.04	44.43
T8:Meteribuzin(300gha^{-1}+Handhoeing)	56.35	71.28	127.63	44.15
T9:Sulfosulfuron(34gha^{-1})	45.64	64.02	109.66	41.61
T10:Sulfosulfuron (28gha^{-1}+Handhoeing)	53.14	69.12	122.26	43.46
SEm±	1.054	0.027	1.055	0.005
C.D.(P= 0.05)	3.155	0.081	3.157	0.015
CV (%)	3.723	0.074	1.798	0.02

Table9.Effectofpreandpostemergenceweedicidesoneconomicsofwheat(TriticumaestivumL.)

TREATMTS	Costofcultivation(Rs./ha)	Grossreturn(Rs./ha)	NetReturn(Rs./ha)	BCR(%)
T1: Weedy check	23380	82237	58857	2.51
T2: Pendimethalin(3000mlha^{-1})	23620	94521	70901	3.00
T3: Pendimethalin(2500mlha^{-1})	25140	97326	72186	2.87
T4: 2,4D-Amine Salt(1000mlha^{-1})	25615	104034	78419	3.06
T5: 2,4D-Amine Salt(800mlha^{-1})	25440	103776	78336	3.07
T6:Clodinofop (395gha^{-1})	25840	102329	76489	2.96
T7:Clodinofop (360gha^{-1})	25690	109911	84221	3.27
T8:Meteribuzin (300gha^{-1}+Handhoeing)	28310	124783	96473	3.40
T9: Sulfosulfuron(34gha^{-1})	26060	106301	80241	3.07
T10:Sulfosulfuron (28gha^{-1}+Handhoeing)	28025	121789	93764	3.34

3.3.1 Cost ofcultivation

The cost of cultivation of wheat varied according to the application of different pre and postemergenceherbicidesamongdifferenttreatments(Table4.10).Costofcultivationwasminimum in weedy check (23380 INR/ha). Highest cost of cultivation of 28310 INR/ha wasobservedinT8:Meteribuzin(300gha^{-1}+ Handhoeing).

3.3.2 Grossreturns

Significantly higher gross returns (124783 INR/ha) were recorded with the application of T_8:Meteribuzin(300gha^{-1}+Handhoeing)whichwasstatisticallyatparwiththeT_{10}:Sulfosulfuron(28gha^{-1}+Handhoeing)withvalueof121789INR/ha.

3.3.3 Netreturns

The data pertaining to net returns of wheat as influenced by various treatments is presented inTable4.10.Significantlyhighernetreturnof96473INR/hawererecordedwiththe application of T_8: Meteribuzin (300 g ha $^{-1}$ + Hand hoeing). Minimum net returns 58857 INR/hawasrecordedintheweedycheck.

3.3.4 Benefitcostratio

The judiciousness of any treatment is determined by the benefit cost ratio. The data on B:Cratio have been presented in Table 4.10. Significantly higher value of B:C ratio was observedwith the treatment T8: Meteribuzin (300 g ha^{-1} + Hand hoeing) is 3.40, which was statistically atparwithT10: Sulfosulfuron(28gha^{-1}+ Handhoeing).

IV. CHAPTER-5 SUMMARY AND CONCLUSION

Inthischapteranattempthasbeenmadetosummarizetheresultspresentedintheexperimental findings, and also to draw valid conclusions based on the significant findings ofthe present investigation entitled, **"Effect of pre and post emergence weedicides on weeddynamics and yield parameters of wheat''**The investigation was conducted during theRabiseasonof2020attheResearchFieldofDepartmentofAgricultureatMaharishiMarkandeshwarUniversity,Sadopur(Haryana).

The trial was carried out in Randomized Block Design with ten treatments viz T_1: weedycheck; T2:Pendimethalin (3000 ml/ha^{-1}), T3:Pendimethalin (2500 ml/ha), T4 :2,4D-Amine Salt(100ml/ha), T5:2,4D- Amine Salt (800ml/ha), T6:clodinofop (395g/ha), T7:Clodinofop(360g/ha), T8: Meteribuzin (300g/ha + Hand hoeing), T9:Sulfosulfuron (34g/ha) and T10:Sulfosulfuron (28g/ha + Hand hoeing). The treatments were replicated thrice. The field wasprepared by ploughing twice with mould board plough followed by harrowing, leveling andridgesformation.The seedrate was 120kg/hainwheat.

Theobservationsofthepresentstudyaresummarizedbelow:

1. ThemaximumplantheightwasrecordedinthetreatmentT$_8$:Meteribuzin(300gha+Handhoeing)
2. Themaximumnumberoftillersat30DASand60DASwereobservedinthetreatmentT$_8$:meteribuzin(300gha^{-1}+Handhoeing).
3. A criticalstudyofthedatarevealedthatthemaximumgrains/spike(42)wasrecordedinT$_8$:meteribuzin(300gha^{-1} +Handhoeing)whichwasfoundatparwithT$_{10}$:Sulfosulfuron (28gha^{-1}+Hand hoeing).
4. Maximumspikelength(8.2cm)recordedwithtreatmentT$_8$:meteribuzin(300gha^{-1}+Handhoeing),whichwasfoundatparwithT$_{10}$:Sulfosulfuron(28gha^{-1}+Handhoeing)andsignificantlysuperiortothe restofthetreatments.
5. Themaximumtestweight(42.3g)wasrecordedin T$_8$:meteribuzin(300gha^{-1}+Handhoeing)whichwasfoundatparwithT$_{10}$:Sulfosulfuron(28gha^{-1}+Handhoeing).
6. The highest weed density at tillering, ear head emergence and dough stage of wheat(Triticum aestivumL.)wasobservedinthe treatmentT1:Weedycheck.
7. The highest weed dry weightat tillering, ear head emergence and dough stage ofwheat(TriticumaestivumL.)wasobservedinthe treatmentT1:Weedycheck.
8. The treatment T8: Meteribuzin (300 g ha^{-1} + Hand hoeing) resulted in the highestweedcontrolefficiency.
9. The data indicated that T8: Meteribuzin (300 g ha^{-1} + Hand hoeing) gave the higheststover yield (71.28 q) which was found at par with T10: Sulfosulfuron (28 g ha^{-1} +Handhoeing).
10. The treatment T8: Meteribuzin (300 g ha^{-1} + Hand hoeing) gave the highest biologicalyield(127.63q) whichwasatpar withT10:Sulfosulfuron(28gha^{-1}+Handhoeing).
11. The treatment T8: Meteribuzin (300 g ha^{-1} + Hand hoeing) gave the highest harvestindex(44.15%) whichwasatpar withT10:Sulfosulfuron(28gha^{-1}+Handhoeing).
12. The highestcostofcultivationof28310INR/hawasobservedin T8:Meteribuzin(300 gha^{-1}+Handhoeing).
13. The highestnetreturn of96473INR/hawererecordedwiththeapplicationofT$_8$:Meteribuzin(300gha^{-1}+ Handhoeing).
14. The highestvalueofB:CratiowasobservedwiththetreatmentT$_8$:Meteribuzin(300 gha^{-1}+ Handhoeing)is 3.40.

CONCLUSION

OnthebasisofresultssummarizedabovE,itcanbeconcludedthatapplicationofT$_8$:Meteribuzin(300g/ha+Handhoeing)inwheatunderfavourableconditionsgavethebestresultsinrespecttogrowth,yieldandnetincome.However,lowestnetincome was observedinweedychecktreatment. Therefore,itcanbeconcludedthattheapplicationofpreandpostherbicideshavepositiveinfluence onthecropyield.

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