Comparison of straw mulching and herbicide levels for controlofvariousweedspeciesinmaize (*Zea mays* L.)

ABSTRACT

Weed management in maize is one of biggest concerns for growers. To reduce dependence on chemicals and chances of herbicide resistant weeds, and to improve soil status, thus straw mulching was added as cultural component with chemicals for improving weed management in maize. Field experiments were conducted at two locations (PunjabAgriculturalUniversity,Ludhiana,andRegionalResearchStation,Gurdaspur)during*kharif*season to find out the influence of different paddy straw mulch and herbicides for control of variousweeds species in maize. The results showed that application of paddy straw mulch 6.25 t/ha effectively controlled*Eleusineindica,Cynodondactylon,Commelinabenghalensis,Eragrostistenella,Digitarias anguinalis, Echinochloacolona, Trianthemaportulacastrum, Portulaca oleracea, Phyllanthusniruri, Euphorbia hirta, Conyza stricta* and *Cyperus compressus*over no mulching. In addition toaboveweedspecies,paddystrawmulch9.0t/haalsoeffectivelyreduceddensityof*Dactylocteniumaegyptium,Acrachneracemosa,Digeraarvensis,Mollugonudicaulis,Alternanthera philoxeroides, Amaranthus viridis*and *Veronica agrestis*and *Cyperus rotundus*ascompared to 6.25 t/haand no mulch treatment. Pre emergence application of atrazine at 1.0 kg/hahelpedtomanage*Eleusineindica,Echinochloacrusgalli,Eragrostistenella,Digitariasanguinalis,Echinochloacolona,Trianthemaportulacastrum,Mollugonudicaulis,Alternanthera philoxeroides, Digera arvensis, Amaranthus viridis*and *Cyperus compressus*incomparisontoatrazineat0.8kg/haandunweededcontrolatallstages.Post emergence application oftembotrione reduced the density of all weed speciescompared to atrazine and unweededcontrol.

Keywords: Atrazine,maize, strawmulching,tembotrione, weedspecies.

INTRODUCTION

Maize being a C_4plant is one of the most important cereal crop grown under diverse soiland climatic conditions. In India, maize-wheat is a major cropping system adopted on a largescale in Indo-gangetic plains of the country. The low productivity in maize may be due to manylimiting factors of which poor weed management poses severe threat to crop productivity. Weeds are the plants which do more harm than benefits. Weeds are the undesirable plants which affectthe crop production both in quality and quantity and also cause reduction in effective resourceutilization by crop plants. Weed control is a major challenge in maize production as weeds cancurtail grain yield by 86% (Bijanzadeh and Hossein 2006). Globally, weed caused 10 per centlosses in agricultural production due to their competitive effect even regular control of weeds inmost agricultural systems (Zimdahl 2004).Worldwidemaizeproduction is hamperedup to 40percent by competition from weeds (Oerke and Dehne 2004). Unchecked weed growth in maize causes yieldlosses even up to 100% (Sharma 2005). Severe infestation due to wider row spacing inflicts hugelosses in yield, may be up to 52 per cent in maize (Walia *et al* 2005). The extent of losses due toweeds, however, depends upon different weed species associated with crop. The

predominantweedspeciesassociated inmaizeare *Dactylocteniumaegyptium,Eleusineindica,Cynodondactylon,Echinochloacolona,Brachiariareptans,Digitariasanguinalis,Sorghumhalepense,Panicum* spp., *Digitariaciliaris, Leptochloa chinensis* and *Commelinabenghalensis*as grasses,*Ageratum conyzoides, Oxalis latifolia, Celosia argentea, Cleome viscosa, Sida acuta, Portulacaoleracea,Phyllanthusniruri,Amaranthusviridis,Tridaxprocumbens,Ipomoeapestigridis,Parthenium hysterophorus*and *Euphorbia hirta*as broadleaf weeds and *Cyperus rotundus*assedges (Sandhu *et al* 1999). These weed species varies with location, climatic conditions, culturalpractices, crop rotation, soil management, weed control measures and inherent weed seed bank inthe soil. Weed plants are blessed with many growth characteristics and adaptations which enablethem to exploit successfully numerous ecological niches. Certain weeds by virtue of favorableadaptationslikesynchronizedgermination,shadingeffectsbythecropatthetimeofestablishment, quick response to available soil moisture and nutrients, adaptation to adverse soiland climatic conditions, herbicide resistance, morphological similarity and ready contaminationwithcropseedsmakethemassociatedwiththespecificcrops.Weedflorachangeswithrespecttolocationviz.*Cyperusrotundus*and*Trianthemaportulacastrum*weredominantweedspeciesin spring maize at Hisar (Singh *et al* 1998) whereas at Orrisa, *Cynodondactylon, Digitariasanguinalis,Digitariaciliaris,Leptochloachinensis,Dactylocteniumaegyptium,Eleusineindica, Cyperus rotundus, Cyperus iria, Celosia argentea, Commelinabenghalensis, Sida acuta*and *Aschynomene indica* were found dominant in rainfed maize.*Cyperus rotundus*as sedges was the most dominant weed in maize fields at Almora, Uttaranchal(Pandey*etal*2001).However,atPantnagarduring*kharif*season*Echinochloacolona,Trianthemaportulacastrum, Cyperus rotundus*and *Eleusine indica* were the dominant weeds inmaizefields (Singh andPrasad 1994).

Due to diverse weed flora, weeds become a major constraint in maize. The yield losses inmaize due to weeds vary from location to location owing differences in management practices,climate and other factors. The success of maize crop depends upon the weed control by usingherbicides. However, herbicides should not be considered as replacement for other weed controlmeasures but can be used in combination with these measures. The use of mulch has shownpromising resultsfor reducing weed pressureinmaize(BhattandKhera2006,SarkarandSingh2007, Anikwe*et al* 2007, Glab and Kulig 2008). Straw mulching in combination with weed control by using herbicides has the potential tomanage diverse weed population. The combination of chemical and non- chemicalapproaches i.e. mulch will help in better control of weeds than use of any single approach inmaize. This information is lacking in literature, so the present study was undertaken to gatherinformationofcontrollingvariousweedspeciesinmaizewithdifferentstrawmulchandherbicidesl evels.

MATERIALSANDMETHODS

Field studies were conducted at two locations during *kharif* season of 2017 as multilocation trial at Research Farm of Punjab Agricultural University, Ludhiana, Punjab, India andResearch Farm of Regional Research Station, Gurdaspur, Punjab, India. Soil at Ludhiana site hada pH of 7.5, 81.50 % sand, 10.80 % silt and 7.70 % clay with available N, P and K of 138.1, 17.2and179.1kg/ha,respectivelywhereasatGurdaspursite,the soilhadapH of7.4,61.11%sand,

12.98 % silt and 25.91 % clay with available N, P and K of 136.6, 18.9 and 195.3 kg/ha,respectively.The study was comprised of three straw mulch treatments: no mulch (NM), paddystraw mulch at 6.25 t/ha(PSM 6.25 t/ha), paddy straw mulch at 9.0 t/ha(PSM 9.0 t/ha) andsix weed control treatments: atrazine at 1.0 kg/ha pre-emergence, atrazine at 0.8 kg/hapre-emergence, tembotrione at 0.110 kg/haat 20 DAS, tembotrione at 0.088 kg/haat 20 DAS,weedfreeandunweededcheck.Theexperimentwaslaidoutinafactorialrandomizedblockdesign withthree replicationsatbothlocations.Maize(hybridPMH1)wassown on June 22, 2017 at Ludhiana whereas at Gurdaspur it was sown on June 6, 2017 using seedrate of 20 kg/ha. Paddy straw mulch (PSM) was applied immediately after the emergence ofmaize seedlings in between the lines as per the treatments. For controlling the weeds, herbicidesAtrataf 50WP(atrazine)aspre-emergence (within2daysof sowing)andLaudis420SC(tembotrione) with activator at 1000 ml/ha as post-emergence (at 20DAS) were applied as pertreatments. The herbicides were applied using knapsack sprayer that delivered 500 l/ha spraysolution for PRE herbicide though flood jet nozzle and 375 l/ha for POST herbicide through aflatfan nozzle.The efficacy of various straw mulch and herbicide levelswas evaluated at 20, 40 DASand at harvest. Two quadrates of 50 cm×50 cm were randomly placed in each plot during eachsampling time to determine the density different weed species. Weed count was recorded byspecies-wise and expressed in number per square meter.Data were analyzed using GLM procedure in SAS 9.3 to evaluate differences betweentreatments. The treatments means were made at P≤0.05 by using Duncun's Multiple Range Test(DMRT).Weeddensitywassquarerootransformated(√x+1)beforeperformingANOVAbecause of high variance. The square root transformated and original values are presented forclearpresentation ofweed data.

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RESULTS AND DISCUSSION

Species-wise weeddensityat 20daysaftersowing:

The data onspecies wise density of differentweedswere recordedat20 days aftersowing(DAS)atboththelocationsandarepresentedintable1and2.Thestudyshowedthatat 20DAS,majorweedspeciesobservedat20DASatLudhianasitewere*Dactyloctenium aegyptium*,*Eleusine indica*and*Commelina benghalensis*amonggrasses,*Trianthema portulacastrum*, *Portulaca oleracea* and *Digera arvensis* among broadleaf weeds and *Cyperus rotundus*and*Cyperus compressus*wererecordedassedgeswhereas,atGurdaspur,*Dactyloctenium aegyptium*and*Cynodon dactylon*asgrasses,*Trianthema portulacastrum*,*Digera arvensis*, *Alternantheraphiloxeroides*and *Amaranthus viridis*were among broadleafweedsandonly*Cyperus rotundus*wasrecordedassedges.*Eleusine indica*,*Commelina benghalensis*and *Euphorbia hirta*were also present at lower densities at Gurdaspur. Diversity inweed flora at different locations was also observed by Ndam *et al* (2014)andSingh *et al* (1998). Pandey *et al* (2001) reported that *Cyperus rotundus*was the mostdominantweedamongsedgesinmaizefields.WhereasatPantnagar,*Echinochloa colona*,*Trianthema portulacastrum*, *Cyperus rotundus*and *Eleusine indica* were observed as dominantweedspecies in maizefields during*kharif* season(Singh and Prasad1994).

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It was observed that application of 9.0 t/hamulch resulted in minimum density of

*D.aegyptium, C. benghalensis, D. arvensis, C. rotundus*and *C. compressus*at Ludhiana and *D.aegyptium,D. arvensis,A. philoxeroides,A.viridis*and*C.rotundus*atGurdaspur ascomparedto 6.25 t/haand no mulch treatments. Similarly, application of both 6.25 t/ha and 9.0 t/ha mulchrecordedstatisticallysimilarandsignificantlylowerdensityof*E.indica,T.portulacastrum*and *P. oleracea* at Ludhiana and *C. dactylon*and *T. portulacastrum*at Gurdaspur as compared to nomulching.

Among weed control treatments, minimum density of all weeds was recordedunderweedfreetreatmentwhereasmaximumdensitywasobservedunderunweededcheck.Fro mtheherbicides,atrazine1.0kg/haresultedinsignificantlylessdensityof*D.aegyptium,C. benghalensis, C. rotundus*and *C. compressus*at Ludhiana and *D. aegyptium, D. arvensis, A.philoxeroides*and *C. rotundus*at Gurdaspurin comparison to its lower dose, but the later onealso significantly controlled the density of *D. aegyptium, D. arvensis* and *C. compressus*atLudhiana and *D. aegyptium*and *D. arvensis* at Gurdaspur as compared to unweeded check.However, the density of *C. dactylon*at Gurdaspur was not significantly influenced by both dosesof atrazine. The higher weed population was observed in both tembotrione treatments at 20 DASbecause this herbicide was applied as post emergence after collection of weed data at 20 DAS.Thus the data showed that initial flush of *D. aegyptium, C. benghalensis, A. philoxeroides, C.rotundus*and *C. compressus*were controlled with the application of atrazine at 1.0 kg/ha within 2 days of sowing, whereas atrazine at 0.8 kg/haapplied within 2 days of sowing effectivelycontrolled *E. indica, T. portulacastrum, A.viridis, P. oleracea*and *D. arvensis*. Chopra andAngiras(2008)alsocorroboratedwiththeresearchfindingsonAtrazineaspre-emergenceapplication.

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Species-wise weeddensityatharvest:

Species-wisedensityofdifferentweedsat harvest was recordedatLudhianaandGurdaspurarepresentedintable3and4.Themajorweedspeciesobservedathar vestatLudhianasitewere*D.aegyptium,E.indica,C.benghalensis,E.tenella,D.sanguinalis*and *E.colona*amonggrasses,*D.arvensis*asbroadleafweedand*C.rotundus*and*C.compressus*wererecorded assedges whereas at Gurdaspur, *D. aegyptium, E. indica, C. dactylon*and*E. tenella*were the majorgrass weed species, *E. hirta, A.viridis, V. agrestis*and *C.stricta*were among broadleaf weeds andonly*C. rotundus*was recorded as sedges. Similar findings with respect to change in weed flora atdifferentlocations were reportedby Singh *et al*(1998).

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Application of 9.0 t/hamulch resulted in significantly less density of *D. aegyptium, C.benghalensis, E. tenella, D. sanguinalis, D. arvensis* and *C. rotundus*as compared to 6.25 t/haand no mulch treatments at Ludhiana,. However, both 6.25 and 9.0 t/hamulch treatmentsrecorded statistically similar and significantly lower density of*E. indica, E. colona*and *C.compressus*ascomparedtonomulchtreatment.OntheotherhandatGurdaspur,applicationof 9.0 t/ha mulch resulted in minimum density of *D. aegyptium, C. dactylon, A. viridis, V. agrestis*and *C. rotundus*as compared to 6.25 t/ha and no mulch treatments. Similarly, both 6.25 t/ha and 9.0 t/ha mulch treatments were statistically similar and significantly better in controlling thedensity of *E. indica, E. tenella, E. hirta*and *C. stricta* as compared to no mulch treatment. Kumarand Angadi(2014) reported that mulch is a good agronomic manipulation for weed management inmaize. Uwah and Iwo (2011) also observed that straw mulch recorded significantly less weeddensity in comparison to no mulch.

In case of herbicidetreatments,applicationoftembotrioneatbothdoses(0.088and0.110kg/ha)resultedinsignificantlybettercontrolof*D.aegyptium,C.benghalensis,E.tenella,D.arvensis*and*C.rotundus*atLudhianaand*D.aegyptium,E.hirta,V. agrestis, C. stricta* and *C. rotundus*at Gurdaspur in comparison to atrazine at both doses (0.8and 1.0 kg/ha) and unweeded check. Whereas, application of tembotrione at both doses andatrazine at 1.0 kg/ha were statistically similar in reducing the density of *E. indica, E. tenella, D.sanguinalis,E.colona*and*C.compressus*atLudhianaand*E.indica,C.dactylon,E.tenella*and*A. viridis*at Gurdaspur but were significantly better as compared to the atrazine at 0.8 kg/haandunweeded check. Atrazine at both doses also recorded significantly better control of all the weedspecies as compared tounweeded checkexcept*C. stricta*which was re- emerged and notcontrolled at harvest. Thus, the results indicated that tembotrione at 0.088 and 0.110 kg/haweremore effective in controlling different weeds species in maize followed by atrazine at 1.0 kg/haand atrazine at 0.8 kg/ha. Rana *et al* (2017) also observed that post emergence application oftembotrioneeffectivelycontrolledthepopulationof*Echinochloacolona,Commelinabenghalensis, Polygonum alatum*and *Ageratumconyzoides*.

Conclussion

It is concluded that applicationofpaddystrawmulch6.25t/haeffectivelycontrolled*E.indica,C.dactylon,C.benghalensis, E.tenella,D.sanguinalis,E.colona,T.portulacastrum,P.oleracea,P. niruri, E. hirta, C. stricta* and*C. compressus*over no mulching. In addition to above species,paddy straw mulch 9.0 t/haalso effectively reduced density of *D. aegyptium, A.racemosa,D.arvensis,M.nudicaulis,A.philoxeroides,A.viridis*and*V.agrestis*and*C. rotundus*as compared to 6.25 t/haand no mulch treatments. Post emergence application oftembotrione at 0.088 and 0.110 kg/hasignificantly reduced the density of all weed speciesobserved in research experiments in comparison to atrazine at 0.8 and 1.0 kg/ha and unweededcheck.

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Table1. Species-wise weed density (number m^{-2}) as influenced by straw mulching and herbicides at20DAS in maize in field experiments conducted at Ludhiana, Punjab

Treatment	Grasses			BLWs*			Sedges	
	D.aegyptium	*E. indica*	*C. benghalensis*	*T. portulacastrum*	*P. oleracea*	*D. arvensis*	*C. rotundus*	*C. compressus*
Strawmulch								
Nomulch	12.05 (185)c	3.57 (18)b	2.83 (8)c	2.02 (4)b	1.50 (2)b	2.96 (9)c	4.66 (24)c	11.51 (167)c
PSM6.25 t/ha	4.50 (26)b	1.00(0)a	2.08 (4)b	1.00 (0)a	1.00 (0)a	2.05 (4)b	3.90 (18)b	5.86 (46)b
PSM9.0 t/ha	3.29 (13)a	1.00(0)a	1.54 (2)a	1.00 (0)a	1.00 (0)a	1.69 (2)a	3.54 (15)a	4.34 (25)a
Weedcontrol								
Atrazineat1.0kg/ha	3.11 (18)b	1.00(0)a	1.66 (3)b	1.00 (0)a	1.00 (0)a	1.41 (1)b	1.86 (4)b	2.93 (15)b
Atrazineat0.8kg/ha	6.64 (53)c	1.14(0.4)a	2.32 (5)c	1.00 (0)a	1.00 (0)a	1.99 (4)b	5.30 (28)c	7.32 (64)c
Tembotrioneat 0.110 kg/ha	9.66(126)d	2.66 (12)b	2.50 (6)cd	1.75 (3)b	1.30 (1)b	2.99 (8)c	5.19 (26)c	10.83 (134)d
Tembotrioneat 0.088 kg/ha	9.64(125)d	2.68 (12)b	2.68 (7)cd	1.66 (2)b	1.41 (1)b	2.98 (8)c	5.40 (29)c	10.69 (131)d
Weedfree	1.00 (0)a	1.00(0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a
Unweeded check	9.64(126)d	2.66 (12)b	2.75 (7)cd	1.67 (3)b	1.29 (1)b	3.03 (9)c	5.44 (29)c	10.64 (131)d

- Dataweresubjectedtosquareroottransformation √x+1.Originalvaluesareinparentheses.
- Inacolumn, means followed bysame letters do notvarysignificantlyat 5%level byDMRT
- BLWs*; BroadLeafWeeds, DAS; Days after sowing,PSM; Paddy straw mulch

Table2. Species-wise weed density (number m^{-2}) as influenced by straw mulching and herbicides at20DAS in maize in field experiments conducted at Gurdaspur, Punjab

Treatment	Grasses		BLWs				Sedges
	D. aegyptium	*C. dactylon*	*T.portulacastrum*	*D.arvensis*	*A.philoxeroides*	*A.viridis*	*C.rotundus*
Strawmulch							
Nomulch	3.49(15)c	2.26(5)b	1.96(4)b	1.72(2)c	2.35(5)c	1.92(4)c	13.40(212)c
PSM6.25 t/ha	2.64(8)b	1.53(2)a	1.22(0.6)a	1.42(1)b	1.17(0.4)b	1.55(2)b	10.13(120)b
PSM9.0 t/ha	1.85(3)a	1.43(1)a	1.17(0.4)a	1.17(0.4)a	1.00(0)a	1.31(1)a	9.18(99)a
Weedcontrol							
Atrazineat1.0 kg/ha	1.72(3)b	1.71(3)a	1.00(0)a	1.00(0)a	1.20(0.6)b	1.00(0)a	10.62(116)b
Atrazineat0.8 kg/ha	1.91(4)c	2.13(4)a	1.00(0)a	1.17(0.4)b	1.58(2)c	1.00(0)a	13.77(191)c
Tembotrioneat 0.110 kg/ha	3.86(16)d	2.16(4)a	2.03(3.5)b	1.88(3)c	1.83(3)d	2.17(4)b	14.02(201)d
Tembotrioneat 0.088 kg/ha	4.02(18)d	2.18(4)a	2.02(3.4)b	1.89(3)c	1.84(3)d	2.10(3)b	13.98(200)d
Weedfree	1.00(0)a	1.00(0)a	1.00(0)a	1.00(0)a	1.00(0)a	1.00(0)a	1.00(0)a
Unweeded check	3.85(15)d	2.17(4)a	2.01(3.4)b	1.93(3)c	1.84(3)d	2.27(4)b	14.06(201)d

- Dataweresubjectedtosquareroottransformation √x+1.Originalvaluesareinparentheses.
- Inacolumn, means followed bysame letters do notvarysignificantlyat 5%level byDMRT
- BLWs*; BroadLeafWeeds, DAS; Days after sowing,PSM; Paddy straw mulch

Table 3. Species-wise weed density (number m^{-2}) as influenced by straw mulching and herbicides atharvest in maize in field experiments conducted at Ludhiana, Punjab

Treatment	Grasses						BLWs*	Sedges	
	D.aegyptium	*E. indica*	*C. benghalensis*	*E.tenella*	*D. sanguinalis*	*E.colona*	*D. arvensis*	*C. rotundus*	*C. compressus*
Strawmulch									
Nomulch	2.60 (8)c	1.24(0.7)b	2.88 (9)c	2.20 (5)c	1.40 (2)c	1.25(0.9)b	1.46 (1)c	3.04 (11)c	1.33 (1)b
PSM6.25 t/ha	2.18 (5)b	1.08(0.2)a	2.39 (5)b	1.65 (2)b	1.09(0.2)b	1.00 (0)a	1.24(0.6)b	2.16 (5)b	1.00 (0)a
PSM9.0 t/ha	1.81 (3)a	1.00 (0)a	1.90 (3)a	1.40 (1)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.76 (3)a	1.00 (0)a
Weedcontrol									
Atrazineat1.0 kg/ha	2.64 (6)b	1.00 (0)a	2.53 (6)c	1.56 (2)a	1.00 (0)a	1.00 (0)a	1.23(0.6)b	2.24 (4)c	1.00 (0)a
Atrazineat0.8 kg/ha	3.21 (10)c	1.73(0.4)b	3.08 (9)d	2.16 (6)b	1.00 (0)a	1.00 (0)a	1.38 (1)c	2.97 (8)d	1.00 (0)a
Tembotrioneat 0.110 kg/ha	1.31(0.9)a	1.00 (0)a	2.14 (4)b	1.27(0.7)a	1.00 (0)a	1.00 (0)a	1.05(0.1)a	1.77 (2)b	1.00 (0)a
Tembotrioneat 0.088 kg/ha	1.29(0.9)a	1.00 (0)a	2..06 (4)b	1.27(0.7)a	1.00 (0)a	1.00 (0)a	1.05(0.1)a	1.65 (2)b	1.00 (0)a
Weedfree	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a
Unweeded check	3.74 (13)d	1.46 (1)c	3.53(12)e	2.84 (8)c	1.98 (4)b	1.50 (2)b	1.70 (2)d	4.31 (20)e	1.67 (3)b

- Dataweresubjectedtosquareroottransformation √x+1.Originalvaluesareinparentheses.
- Inacolumn, means followed bysame letters do notvarysignificantlyat 5%level byDMRT
- BLWs*; BroadLeafWeeds, DAS; Days after sowing,PSM; Paddy straw mulch

Table4. Species-wise weed density (number m^{-2}) as influenced by straw mulching and herbicides at20DAS in maize in field experiments conducted at Gurdaspur, Punjab

Treatment	Grasses				BLWs*				Sedges
	D. aegyptium	*E.indica*	*C. dactylon*	*E.tenella*	*E.hirta*	*A.viridis*	*V.agrestis*	*C.stricta*	*C. rotundus*
Strawmulch									
Nomulch	1.96 (3)c	1.66(2)b	1.91 (3)c	1.99(4)b	1.68 (2)b	1.38 (1)c	2.56 (7)c	1.69 (2)b	4.75 (26)c
PSM6.25 t/ha	1.81 (3)b	1.21(0.6)a	1.55 (2)b	1.35(1)a	1.38 (1)a	1.09(0.2)b	1.89 (3)b	1.37 (1)a	4.13 (19)b
PSM9.0 t/ha	1.27	1.19	1.27	1.24	1.30	1.00	1.45	1.32	3.34
Nomulch	(0.9)a	(0.6)a	(0.8)a	(0.8)a	(0.8)a	(0)a	(1)a	(0.9)a	(13)a
Weedcontrol									
Atrazineat 1.0 kg/ha	1.71 (2)c	1.25 (0.7)a	1.51 (2)b	1.22 (0.7)a	1.48 (1)b	1.00 (0)a	2.36 (5)b	1.61 (2)b	4.94 (24)c
Atrazineat 0.8 kg/ha	1.80 (3)c	1.40 (1.3)b	1.77 (2)c	1.86 (3)b	1.65 (2)b	1.17 (0.4)b	2.67 (7)b	1.97 (3)c	5.50 (30)d
Tembotrione at0.110 kg/ha	1.47 (1)b	1.17 (0.4)a	1.38 (1)b	1.17 (0.4)a	1.00 (0)a	1.00 (0)a	1.41 (1)a	1.00 (0)a	3.39 (11)b
Tembotrione at0.088 kg/ha	1.54 (1.6)b	1.17 (0.4)a	1.41 (1)b	1.22 (0.7)a	1.27 (0.7)a	1.00 (0)a	1.13 (0.4)a	1.00 (0)a	3.5 (11)b
Weedfree	1.00 (0)a	1.00(0)a	1.00 (0)a	1.00(0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a	1.00 (0)a
Unweeded check	2.56 (6)d	2.11(4)c	2.38 (5)d	2.7(8)c	2.32 (5)c	1.76 (3)c	3.22 (11)c	2.18 (4)c	6.27 (39)e

- Dataweresubjectedtosquarerroottransformation √x+1.Originalvaluesareinparentheses.
- Inacolumn, means followed bysame letters do notvarysignificantlyat 5%level byDMRT
- BLWs*; BroadLeafWeeds, DAS; Days after sowing, PSM; Paddy straw mulch

Comment [Anandhi S10]: check the title it should be harvest