EFFECT OF A NEW POST EMERGENCE HERBICIDE APPLICATION IN COMBINATION WITH UREA ON GROWTH, YIELD AND WEEDS CONTROL IN MAIZE, *ZEA MAYS* L.

M. Naveed, R. Ahmad, M. A. Nadeem**, S. M. Nadeem, K. Shahzad* and M. A. Anjum****

ABSTRACT

A study was conducted at the Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan during 2005. In this study effectiveness of various doses of a new post-emergence herbicide Equip (foramsulfuron + isoxadifen-ethyl) applied in combination with 3 percent urea solution was assessed on growth, yield and weeds of autumn planted maize. Layout system was RCBD with four replications having a net plot size of 5 x 3 square meter. Recommended dose of PK (100-50 kg/ha) was applied at sowing while N was applied in two splits. Main weeds were *Trianthema portulacastrum, Cyperus rotundus* and *Coronopus didymus.* The results revealed that herbicide application in combination with urea solution performed better than use of herbicide alone. Weeds density, fresh and dry weight 20 and 40 days after sowing and at harvest decreased significantly when foramsulfuron + isoxadifen-ethyl was applied @ 1125 g a.i. per hectare plus 3 percent urea solution as adjuvant as compared to herbicide alone. Full dose of herbicide alone performed statistically similar to reduced dose of herbicide (1012 g a. i. + 3 percent urea) in minimizing weed density, fresh/dry weight and increasing maize yield. The study concludes that herbicide dose can be reduced upto 10 percent if urea solution is used as adjuvant without compromising on maize yield loss due to weeds.

KEYWORDS: *Zea mays;* weeds; herbicides; urea; Pakistan.

INTRODUCTION

Maize (*Zea mays* L.) is the world's third most important cereal grain after wheat and rice. It is grown primarily for grain and secondarily for fodder. In Pakistan it is grown on an area of 1.022 million hectares with a production of 3.560 million tons and an average grain yield of 3483 kg per hectare (3).

*Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, **Department of Agronomy, University of Agriculture, Faisalabad, ***Soil Bacteriology Section, Ayub Agricultural Research Institute, Faisalabad, Pakistan.

Among various factors responsible for low yield, weed infestation is of supreme importance. Worldwide maize production is hampered upto 40 percent by competition from weeds which are the most important pest group of this crop (17). Weeds reduce crop yield by competing for light, water, nutrients and carbon dioxide, interfere with harvesting and increase the cost involved in crop production. Overall, weeds had the highest loss potential (37%) which is higher than loss potentials of animal pests (18%), fungal and bacterial pathogens (16%) and viruses (2%) (18).

The farmers undertake weed control to one degree or another but it is one of the most labour intensive activities for small scale farmer, especially in areas where high temperature and regular rainfall encourage rapid weed growth (11). Losses caused by these weeds can be considerably reduced by use of selective herbicides but these may be too expensive for many farmers (24).

Control of weeds from the fields of maize is, therefore, very essential for obtaining good crop harvest. Weed control practices in maize resulted in 77 to 96.7 percent higher yield than weedy check (13). Weeds can be controlled by cultural, biological and chemical measures. No doubt, cultural methods are still useful tool but it is laborious, time consuming and expensive especially when labour problem is becoming severe day by day.

Considering these limitations, chemical weed control is an important alternative. Herbicide application is an efficient way to check weed infestation that helps achieve a speedy breakthrough for increasing maize production. Weed control in maize with herbicides has been suggested by some researchers (6, 30).

Use of ammonium nitrate as an adjuvant contributes to improved penetration and enhanced phytotoxicity consequently reduced the fresh weight of weeds (5). Herbicide applied in combination with urea gives better result upto 12 to 13.5 percent than use of herbicide alone (10). It is, therefore, imperative to generate comprehensive information regarding safe and effective use of chemicals on various crops.

The present study was conducted to see the effect of a new herbicide Equip (foramsulfuron + isoxadifen-ethye) alone and in combination with urea on weeds and maize yield.

MATERIALS AND METHODS

This study was carried out in Agronomy Department, University of Agriculture, Faisalabad during 2005. Layout system was RCBD with four replications having a net plot size of 5 x 3 meter. Maize variety C-20 was sown on 5th July, 2005 with single row hand drill using a seed rate of 35 kg per hectare in 75 cm apart rows. Plant to plant distance of 25 cm was maintained by thinning at an early growth stage. Recommended dose of NPK (175-100-50 kg/ha) was applied as urea, single super phosphate (SSP) and muriate of potash (MOP) according to treatments. Fertilizers P_2O_5 and K_2O were applied as basal dose and half of N was broadcasted and incorporated in the soil at sowing while remaining half of N was top dressed at the time of second irrigation. Good quality canal water [electrical conductivity = 0.03 dS/m; sodium adsorption ratio = 0.26 (m mol/L)½ and residual sodium carbonate = 0] was used for irrigation meeting irrigation quality criteria (4).

W_1	=	Weedy check
W_2	=	Manual hoeing (2 hoeings)
W_3	=	Foramsulfuron + isoxadifen-ethyl (1125 g a.i/ha) alone
W_4	=	Foramsulfuron + isoxadifen-ethyl (1125 g a.i/ha) + 3% urea
W_5	=	Foramsulfuron + isoxadifen-ethyl (1012 g a.i/ha) + 3% urea
W_6	=	Foramsulfuron + isoxadifen-ethyl (900 g a.i/ha) + 3% urea

The spray volume was determined by calibration before spraying herbicide. The herbicide was sprayed 10 days after crop and weeds emerged by "Knapsack" hand sprayer using flat fan nozzle. Hoeing was done twice with hand hoe in manual hoeing treatment when soil was in field capacity condition after first and second irrigation. All other agronomic practices were kept normal and uniform for all treatments. Main weeds in this field were *Trianthema portulacastrum, Cyperus rotundus* and *Coronopus didymus*. Data regarding weeds density, weeds biomass, plant height, number of grain rows per cob, 100-grain weight, total cob weight, grain yield and stalk yield were recorded using standard procedure.

The data collected on weeds and crop parameters were analyzed statistically by using Fisher's analysis of variance technique and least significant difference test was applied ($P < 0.05$) to compare treatment means (29).

RESULTS AND DISCUSSION

Weed density at 20 days after sowing

The data regarding weed population revealed that weed density at 20 days after sowing (DAS) was significantly affected by all weed control treatments (Table 1). Maximum weed density (342.67/m^2) was recorded in weedy check (W_1) followed by foramsulfuron + isoxadifen-ethyl (900 g a.i/ha) + 3 percent urea (W_6) which was statistically at par with herbicide application of 1012 g a.i. in urea solution (W_5). Significantly minimum weed density (9.32/m^2) was recorded in manual hoeing (W_2). Addition of urea alongwith full dose of herbicide (W_4) resulted in significantly lower weed density (167.37/m^2) against application of herbicide alone (W_3). Weed density, however, increased at lower herbicide dose alongwith urea. Although weed density increased significantly when herbicide dose was reduced to 1012 g a.i. (W_5), yet it was statistically similar to full dose of herbicide alone indicating that herbicide dose can be reduced if urea is used as adjuvant to obtain same efficiency. The decreased weed density in manual hoeing was due to eradication and mechanical injury of plants. The decreased weed density with addition of urea as adjuvant might have been due to increased permeability and more absorption of herbicide by leaves (5). These results are close in line with other studies (6, 13). Many scientists (2, 12, 16, 22, 28) observed that hand weeding and herbicidal treatments effectively minimized weed competition. Similarly, Rola *et al.* (20) also reported that herbicide alongwith adjuvant reduced weed density as compared to herbicide alone.

Table 1. Weeds density, *T. portulacastrum, C. rotundus* fresh weigh (g/m^2) and fresh/dry weight of weeds (g/m^2) at 20 DAS as influenced by various weed control treatments (average of 4 replicates).

Treatments	Weeds density	*T. portulacastrum* fresh weight	*C. rotundus* fresh weight	Fresh weight of weeds	Dry weight of weeds
Weedy check (W_1)	342.67a*	1864.00a	11.08a	1875.08a	636.80a
Manual hoeing (2 hoeings) (W_2)	9.32e	7.13f	1.63c	8.76f	2.49e
Foramsulfuron + isoxadifen-ethyl @ 1125 g a.i./ ha alone (W_3)	222.00c	955.10d	7.46b	962.56d	326.16c
Foramsulfuron+isoxadifen-ethyl @ 1125 g a.i. /ha+3% urea (W_4)	167.37d	729.00e	7.89ab	736.89e	248.01d
Foramsulfuron+isoxadifen-ethyl @ 1012 g a.i. /ha +3% urea (W_5)	236.03bc	1107.00c	9.26ab	1116.26c	372.04c
Foramsulfuron + isoxadifenethyl @ 900 g a.i. /ha + 3% urea (W_6)	248.63b	1509.00b	10.71ab	1519.71b	505.28b
LSD values	15.96	25.16	3.478	37.37	56.51

*Any two means sharing same letters did not differ significantly (P = 0.05)

T. portulacastrum fresh weight (g/m^2) at 20 DAS

The data (Table 1) revealed that maximum fresh weight (1864 g/m^2) of *T. portulacastrum* was recorded in weedy check at 20 DAS against minimum in manual hoeing (7.13 g/m^2). Maximum fresh weight in weedy check plots was due to more density and unchecked weeds growth. The decreased fresh weight of *T. portulacastrum* with addition of urea as adjuvant might have been due to increased permeability and more absorption of herbicide by leaves and less number of weeds. Variation in fresh weight of *T. portulacastrum* in different weed control treatments was due to varying effect of herbicides and hoeing on number of weeds. These results are supported by many earlier workers (9, 12, 19, 31).

C. rotundus fresh weight at 20 DAS

The data (Table 1) further revealed that all weed control treatments significantly decreased fresh weight of *C. rotundus* as compared to weedy check at 20 DAS. Significantly maximum reduction (85.26%) in *C. rotundus* fresh weight (1.63 g/m^2) was recorded in manual hoeing treatment. Maximum *C. rotundus* fresh weight (11.08 g/m^2) was recorded in weedy check which is attributed to more number of weeds and their vigorous growth. These results are supported by previous workers (9, 12, 19, 31) who reported that weed number and weed fresh weight was higher in weedy check plots and lower in chemical weed control treatments.

Fresh weight of weeds at 20 DAS

Maximum fresh weight of weeds (1875.08 g/m^2) was recorded in weedy check (Table 1). Minimum weed fresh weight was recorded in manual hoeing (8.76 g/m^2) with 99.53 percent reduction. Use of urea as adjuvant with full dose of herbicide was found effective and resulted in significantly lower fresh weight compared with herbicide application alone. However, reducing herbicide dose alongwith urea (W_5 and W_6) gave higher fresh weight than herbicide alone (W_3). Variation in fresh weight of weeds in different weed control treatments was due to varying effect of herbicides. These results are supported by other workers (9, 12, 19, 31) who reported that herbicides reduce weeds density and weeds biomass. Similarly Young and Hart (33) also reported that addition of adjuvant to isoxaflutole @ 10 g a.i. per hectare reduced growth by 75 percent against foxtail.

Dry weight of weeds at 20 DAS

The data revealed that maximum weed dry weight (636.9 g/m^2) was recorded in weedy check (W_1) followed by W_6 (foramsulfuron + isoxadifen-ethyl @ 900 g a.i/ha + 3% urea) (Table 1). Minimum weed dry weight (2.49 g/m^2) was recorded in manual hoeing with 99.6 percent weed control. Application of full dose of herbicide alongwith 3 percent urea solution resulted in significantly lower dry weight compared with full dose of herbicide alone. Although weed dry weight increased significantly when herbicide dose was reduced (upto 1012 g a.i/ha + 3% urea). However, it was statistically similar to full dose of herbicide alone indicating that herbicide dose can be reduced to 10 percent if urea is used as adjuvant (5). The decreased weed dry weight in manual hoeing was due to less number of weeds and their fresh weight. This effect was also reported earlier (6, 13) where the lowest weeds dry weight was recorded in hand weeding and chemical weed control treatments. Simialrly, Young and Hart (33) also reported similar results.

Weed density at 40 DAS

Maximum weed density (274.63/m^2) was recorded in weedy check followed by W_6, (foramsulfuron + isoxadifen-ethyl @ 900 g a.i/ha + 3% urea) (Table 2). Minimum weed density was recorded in manual hoeing (56 g/m^2). Application of full dose of herbicide plus 3 percent urea solution resulted in significantly lower weed density compared with herbicide alone. Weed density, however, increased at lower herbicide dose alongwith urea (W_5 and W_6) as compared to W_4. Although weed density increased significantly when herbicide dose was reduced to 1012 g a.i + 3% urea (W_5), yet it was statistically similar to full dose of herbicide alone. Minimum weed density with addition of urea as adjuvant might have been due to increased permeability and more absorption of herbicide by leaves (33). These results support the findings of previous workers (6, 13, 14, 32) who stated that herbicidal treatments and manual hoeing reduced the weed density.

T. portulacastrum fresh weight at 40 DAS

The results (Table 2) revealed that minimum fresh weight of *T. portulacastrum* (73.20 g/m^2) was recorded in manual hoeing at 40 DAS. Decrease in fresh weight of *T. portulacastrum* with addition of urea as adjuvant might have been due to increased permeability and more absorption of herbicide by leaves and less number of weeds leaves (33). Variation in fresh weight of *T. portulacastrum* in different weed control treatments was due to varying effect of herbicides and hoeing on number of weeds. These results agree to the earlier findings (9, 12, 19, 31) where higher weed fresh weight was found in weedy check plots and lowest in chemical weed control treatments.

Table 2. Weeds density, *T. portulacastrum, C. rotundus* fresh weigh (g/m^2) and fresh/dry weight of weeds (g/m^2) at 40 DAS as influenced by various weed control treatments (average of 4 replicates).

Treatments	Weeds density (m^2)	*T. portulacastrum* fresh weight	*C. rotundus* fresh weight	Fresh weight of weeds	Dry weight of weeds
Weedy check (W_1)	274.63a*	1088.00a	13.90a	1101.90a	424.88a
Manual hoeing (2 hoeings) (W_2)	56.00e	73.20f	8.66bc	81.86f	20.25f
Foramsulfuron + isoxadifen-ethyl @ 1125 g a.i./ ha alone (W_3)	172.03c	217.10d	11.33ab	228.43d	88.83d
Foramsulfuron + isoxadifen-ethyl @ 1125 g a.i. /ha+3% urea (W_4)	104.00d	180.70e	5.26c	185.96e	70.21e
Foramsulfuron + isoxadifen-ethyl @ 1012 g a.i. /ha +3% urea (W_5)	181.97c	285.80c	13.57a	299.37c	117.25c
Foramsulfuron + isoxadifen-ethyl @ 900 g a.i. /ha + 3% urea (W_6)	230.70b	412.50b	8.66bc	421.16b	163.42b
LSD values	12.01	18.49	3.469	18.03	10.05

*Any two means sharing same letters did not differ significantly (P = 0.05)

C. rotundus fresh weight at 40 DAS

Minimum fresh weight (5.26 g/m^2) of *C. rotundus* was recorded in W_4 (foramsulfuron + isoxadifen-ethyl @ 1125 g a.i. ha + 3 % urea) which was statistically at par with W_2 and W_6 treatments. Maximum *C. rotundus* fresh weight (13.9) was recorded in weedy check. Decrease in fresh weight of *C. rotundus* in different treatments was due to less number of weeds. Some earlier workers (9, 12, 31) also report similar findings.

Fresh weight of weeds at 40 DAS

Maximum fresh weight of weeds (1101.9 g/m^2) was recorded in weedy check (Table 2). Use of urea as adjuvant with full dose of herbicide (W_4) was found effective and resulted in significantly lower fresh weight compared with application of herbicide alone. Minimum fresh weight (81.86 g/m^2) was recorded in manual hoeing treatment. Decrease in fresh weight of weeds in different weed control treatments was due to less number of weeds and their suppression by herbicide. These results are supported by others (9, 19, 31) who found that application of weedicides resulted in decreased weed biomass.

Dry weight of weeds at 40 DAS

Maximum weeds dry weight (424.88 g/m^2) was recorded in weedy check (W_1) followed by W_6 (163.42 g/m^2) (Table 2). Significantly minimum weed dry weight (20.25 g/m^2) was recorded in manual hoeing with 95.23 percent weed control. Application of full dose of herbicide alongwith 3 percent urea solution resulted in significantly lower dry weight compared with herbicide alone. Weed dry weight, however, increased at lower hebicide dose alongwith urea (W_5 and W_6) as compared to W_4. The decreased weed dry weight in manual hoeing can be attributed to less number of weeds and their fresh weight. These results confirm earlier findings (25, 23) where weed control treatments significantly reduced dry matter accumulation of weeds. Similarly Young and Hart (33) also reported that addition of adjuvant to isoxaflutole (10 g a.i/ha) reduced weeds dry weight.

Weed density at harvest

Coronopus didymus, a new weed emerged at time of harvest, while *T. portulacastrum* was not present at that time due to its off-season. Maximum weed density (61.33/m^2) was recorded in weedy check (Table 3). Minimum weed density (37.33) was recorded in W_4 (foramsulfuron + isoxadifen-ethyl @ 1125 g a.i/ha + 3% urea). It was statistically similar to all other weed control treatments. Earlier findings (6, 13, 14, 34) also support the present results. The application of herbicide alongwith adjuvant reduced weed density as compared to herbicide alone (20).

Fresh weight at harvest

In case of *C. didymus,* maximum fresh weight (64.30 g/m^2) was recorded in weedy check at harvest which was statistically at par with manual hoeing. Minimum *C. didymus* fresh weight (29.40 g/m^2) was recorded in W_5 (foramsulfuron + isoxadifen-ethyl @ 1012 g a.i. ha + 3 % urea). Maximum *C. didymus* fresh weight in weedy check plots was due to more number of weeds and their growth. These results are supported by previous scientists (9, 12, 19, 31) who reported that application of herbicides decreased fresh weight of weeds.

Similarly maximum *C. rotundus* fresh weight (24.70 g) was also recorded in weedy check (W_1) at harvest which was statistically at par with W_3 and W_5 treatments. Minimum fresh weight (13.53 g/m^2) of *C. rotundus* was recorded in W_6 (foramsulfuron + isoxadifen-ethyl @ 900 g a.i. /ha + 3% urea) which was statistically at par with W_4 and W_2**.**

Data on fresh weight of both weeds demonstrated that maximum fresh weight of weeds (89 g/m^2) was recorded in weedy check (Table 3) which was statistically at par with manual hoeing. Minimum weeds fresh weight (46.67 g/m^2) was recorded in W_4 (foramsulfuron + isoxadifen-ethyl @ 1125 g a.i/ha + 3% urea). It was statistically at par with all weed control treatments except manual hoeing. Decrease in fresh weight of weeds in different weed control treatments was due to less number of weeds. These results are supported by some previous workers (9, 19, 31) who reported maximum fresh weight in weedy check.

Table 3. Weeds density, *C. didymus, C. rotundus* fresh weight (g/m^2) and fresh/dry weight of weeds (g/m^2) at harvest as influenced by various weed control treatments (average of 4 replicates).

Treatments	Weeds density	*C. didymus* fresh weight	*C. rotundus* weight	Fresh weight of weeds	Dry weight of weeds
Weedy check (W_1)	61.33a*	64.30a	24.70a	89.00a	34.03a
Manual hoeing (2 hoeings) (W_2)	46.67b	57.80a	16.87bc	74.67a	26.19b
Foramsulfuron + isoxadifen-ethyl @ 1125 g a.i./ ha alone (W_3)	45.33b	30.27b	20.23ab	50.50b	20.77bcd
Foramsulfuron + isoxadifen-ethyl @ 1125 g a.i./ ha+3% urea (W_4)	37.33b	30.00b	16.67bc	46.67b	15.80d
Foramsulfuron + isoxadifen-ethyl @ 1012 g a.i. /ha +3% urea (W_5)	42.67b	29.40b	21.23ab	50.63b	19.46cd
Foramsulfuron + isoxadifen-ethyl @ 900 g a.i. /ha + 3% urea (W_6)	46.00b	34.77b	13.53c	48.30b	23.13bc
LSD values	9.480	11.56	9.853	14.44	5.77

*Any two means sharing same letters did not differ significantly (P = 0.05)

Dry weight of weeds at harvest

Maximum weed dry weight (34.03 g/m^2) was also recorded in weedy check (W_1) against minimum in W_4 (foramsulfuron + isoxadifen-ethyl @ 1125 g a.i/ha) + 3% urea) (15.80 g/m^2) which was statistically at par with W_3 and W_5. Weed dry weight, however, increased at lower herbicide dose alongwith urea (W_5 and W_6) as compared to W_4. The decreased weeds dry weight with addition of urea as adjuvant might have been due to increased permeability and more absorption of herbicide by leaves (33). These results are in conformity with those of earlier researchers (6, 22, 23, 25). They determined that all weed control treatments resulted in a significantly higher maize grain yield as compared to untreated control due to a significant reduction in density and dry matter accumulation of weeds.

Plant height at maturity

The data (Table 4) indicated that maximum plant height (216.70 cm) was observed in manual hoeing which was statistically at par with W_4 and W_3. Minimum plant height (195.70 cm) was recorded in weedy check. Decrease in plant height may be due to suppression of vegetative growth of plants by weeds competition for light, moisture and nutrients. Variations in plant height could be attributed to varying effect of weed competition offered by different weed densities in different treatments. These results confirm the findings of other workers (14, 25). They found that use of herbicides to control weeds resulted in increased plant height.

Table 4. Plant height (cm), number of grain rows per cob, 100-grain weight (g), total cob weight (t/ha), grain yield (t/ha) and stalk yield as influenced by various weed control treatments.

Treatments	Plant height	No. of grain rows/cob	100-grain weight (g)	Total cob weight (t/ha)	Grain yield (t/ha)	Stalk yield (t/ha)
Weedy check (W_1)	195.72d*	12.47d	21.18c	4.52d	2.83d	9.08b
Manual hoeing (2 hoeing) (W_2)	216.67a	15.45ab	25.06a	6.79a	5.04a	11.40a
Foramsulfuron + isoxadifen-ethyl @ 1125 g a.i./ ha alone (W_3)	212.67abc	14.67abc	23.32b	5.79b	4.46b	9.65b
Foramsulfuron + isoxadifen-ethyl @ 1125 g a.i./ ha+3% urea (W_4)	213.75ab	15.94a	25.37a	6.99a	5.14a	10.63ab
Foramsulfuron + isoxadifen-ethyl @ 1012 g a.i. /ha +3% urea (W_5)	207.80bc	14.00bcd	23.14b	5.96c	4.26bc	9.89ab
Foramsulfuron + isoxadifen-ethyl @ 900 g a.i. /ha + 3% urea (W_6)	203.00c	13.07cd	23.15b	5.83bc	4.08c	10.41ab
LSD values	7.667	1.739	1.502	0.3626	0.3044	1.693

*Any two means sharing same letters did not differ significantly (P = 0.05)

Number of grain rows per cob

Maximum number of grain rows per cob was recorded in W_4 (foramsulfuron + Isoxadifen-ethyl @ 1125 g a.i. /ha + 3% urea) (15.94 rows) which was statistically at par with W_2 and W_3. Minimum number of grain rows per cob (12.47) was recorded in weedy check. From these results it was observed that good weed control was effective to get higher number of grain rows per cob. Many workers (1, 14, 27) also reported less grain rows per cob in untreated plot.

100-grain weight

The highest 100-grain weight (25.18 g) was recorded in W_4 which was statistically at par with W_2. Significantly minimum 100-grain weight (21.49 g) was recorded in weedy check (W_1). More 100-grain weight in weed control treatments than weedy check was due to better growth and development of maize plant, which resulted in more seed assimilates. El-Bially (8) also reported that 100-grain weight was greater in chemical and mechanical weed control treatments than untreated control.

Total cob weight

Maximum cob weight (6.99 t/ha) was recorded in W_4 (foramsulfuron + isoxadifen-ethyl @ 1125 g a.i./ha + 3% urea) which was statistically at par with manual hoeing (6.79 t/ha) (Table 4). The cob weight recorded in W_3 (5.79 t/ha) was statistically at par with W_6. Minimum cob weight (4.52 t/ha) was recorded in weedy check which was due to the adverse effect of weeds on crop plants. Maximum cob weight in W_4 can be attributed to more cob length, number of grains and grain weight. These results are supported by earlier findings (1, 14, 27).

Grain yield

All weed control treatments significantly increased maize grain yield over weedy check. W_4 (foramsulfuron + isoxadifen-ethyl @ 1125 g a.i. /ha + 3% urea) gave higher grain yield (5.14 t/ha) and was statistically similar with manual hoeing (5.04 t/ha). Application of full dose of foramsulfuron + isoxadifen-ethyl (1125 a.i/ha) alone produced 4.46 tons per hectare which was statistically at par with reduced dose of herbicide with 3 percent urea (W_5). It indicated that herbicide dose can be reduced if urea is used as adjuvant to obtain same efficiency. Significantly minimum grain yield (2.83 t/ha) was recorded in weedy check. Higher grain yield was due to more number of grains per cob, grain weight per cob and 100-grain weight as compared to weedy check. Efficiency of chemicals and other weed control practices in increasing grain yield had also been demonstrated by some scientists (7, 14, 15, 26). They reported that use of herbicides like Primextra, atrazine and metalachlor resulted in increased maize yield significantly as compared to weedy control. The addition of adjuvants enabled the reduction in herbicide concentration by 3-60 percent in corn without affecting its yield (21).

Stalk yield

The data (Table 4) depict that stalk yield varied significantly among various weed control treatments. Maximum stalk yield was obtained in manual hoeing (11.40 t/ha) which was statistically at par with all other treatments except weedy check (9.08 t/ha) and W_3. More stalk yield in weed control treatments than weedy check was due to better growth and development of maize plants, which resulted in more biomass of maize plants. These results are in close agreement with previous findings (7, 27) who reported less stalk yield in weedy check treatments.

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