

**INFLUENCE OF HERBICIDES AND CULTURAL PRACTICES
ON UPTAKE OF NUTRIENTS BY CROP AND WEEDS AND
THEIR EFFECT ON QUALITY PARAMETERS**

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ABSTRACT

An experiment was conducted during kharif seasons of the year 2012-13 and 2013-14 on medium black clayey soil at Junagadh Agricultural University, Junagadh to study the effect of herbicides and cultural practices on uptake of nutrients by crop and weeds and their effect on quality parameters. Besides weed free, results revealed that significantly higher uptake of nutrients by crop and lower uptake by weeds were recorded with HW & IC at 20 & 40 DAS followed by pendimethalin 30% EC @ 0.900 kg/ha as PE + imazethapyr @ 75 g/ha as POE at 20 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + HW & IC at 40 DAS, and propaquizafop @ 90 g/ha as POE at 20 DAS + HW & IC at 40 DAS and also improved the protein and oil per cent in kernel.

KEY WORDS: *Arachis hypogaea*, groundnut, herbicide, microflora

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a species in the legume or bean family (Fabaceae). It is also known as Earthnut, Peanut, Monkeynut, Monilanut, Pignut, Pinda and Gobbernut. It is an important food, fodder and cash crop for the farmers of India. It contains about 49.24 per cent edible oil and the remaining per cent kernels seed has high qualities of protein (25.80%), carbohydrate (16.13%), dietary fibre (8.5%), minerals and vitamins. The nutrients like protein, thiamine, riboflavin, niacin and vitamin "E" are also available in higher quantities in groundnut than dry fruits. Groundnut oil is normally used for cooking purpose and preparation of vegetable, organic manure and animal feed. It

contains 7-8% N, 1-5% P₂O₅ and 1% K₂O. Apart from oil and cake, the haulm is very good source of quality fodder for animal as compared to other feed crops.

Groundnut is the third largest oilseed produced crop in world. Groundnut is grown in tropical and sub-tropical regions and in the continental part of temperate countries. The major groundnut producing countries of the world are India, China, Nigeria, Senegal, Sudan, Burma and the USA. These countries accounted for 69 per cent of the area and 70 per cent of the production. It covers total area of 18.9 million hectares with production of 17.8 million tonnes in the world (Madhusudana, 2013). India along with china accounts for half of the world's groundnut production

today. The average area under groundnut cultivation in India during 2011-12 was 4.19 million hectares with production of 5.62 million tonnes and productivity of 1341 kg/ha (DOAC, 2012). Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka together account for 77 per cent of the area and almost 75 per cent of the production of groundnut in India (Mehrotra, 2011).

In Gujarat, the region of Saurashtra is considered to be the groundnut oil bowl of the country. The average area under groundnut cultivation in Gujarat during 2011 stood at 19.22 lakh hectares with production of 35.75 lakh tonnes and productivity of 1860 kg/ha (DOA, 2012). Groundnut is cultivated in all the district of Gujarat state, however, about 82 per cent areas is covering by Junagadh, Rajkot, Amreli and Surendranagar districts of Saurashtra region. The average area under groundnut cultivation in Junagadh district during 2011 was 4.42 lakh hectares with production of 9.57 lakh tonnes and productivity of 2162 kg/ha (DOA, 2012).

MATERIAL AND METHODS

The study was conducted at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) during *kharif* seasons of the year 2012-13 and 2013-14 in order to study the effect of herbicides on soil microbial population and residual effect on succeeding crops, which is situated in South Saurashtra Agro-climatic region of Gujarat state and enjoys a typically sub-tropical situated at 21.5° N latitude and 70.5° E longitude with an altitude of 60 m above the mean sea level on the western side at the foothill of mountain 'Girnar' by fairly cool and dry winter, hot and dry summer, and

warm and moderately humid monsoon. The maximum and minimum temperature during the crop growth period ranged between 29.9 °C to 37.7 °C and 17.6 °C to 27.2 °C, respectively during 2012-13. The soil was medium clayey in texture and slightly alkaline in reaction with pH (8.05 and 7.98) and EC (0.33 and 0.29 dS/m), low in available N (244.60 and 237.8 kg/ha), medium in available P (21.54 and 23.34 kg/ha) and available K (235.2 and 249.18 kg/ha), respectively. Available N, available P and available K were analyzed following Alkaline KMnO₄ method (Subbaiah and Asija, 1956), Olsen's method (Olsen *et al.*, 1954) and Flame photometric method (Jackson, 1974), respectively.

Twelve treatment combination comprising pre- and post-emergence herbicides and their integration with manual weeding were evaluated in randomized block design with three replications during both the years in a gross and net plot of 6.0 m × 4.8 m and 5.0 m × 3.6 m. Pre-emergence (PE) and post-emergence (POE) application of herbicides was done using spray volume of 500 l/ha on the next day of sowing and at 20 days after sowing (DAS). Groundnut variety GG-20 was sown on July, 11th and June, 26th during 2011-12 and 2012-13, respectively by placing the seed manually at 10 cm intra row spacing in previously opened furrow at 60 cm inter row spacing with seed rate of 120 kg/ha. Gape filling and thinning was carried out at 10 DAS and crop harvested at maturity on 31-10-2012 and 22-10-2013 in respective years. The recommended fertilizer for *kharif* groundnut was 12.5 kg N/ha, 25 kg P₂O₅/ha and 0 kg K₂O/ha. The whole quantity of N and P₂O₅ was applied through urea and single superphosphate at the time of sowing of groundnut. Three and two irrigation

were given during the study in 2012-13 and 2013-14.

RESULTS AND DISCUSSION

Effect on nutrient content in crop

The content of nutrients in pod and haulm were significantly influenced by different weed management treatments. Significantly higher value of N, P and K content in pod and haulm were recorded with weed free, which remained statistically at par with HW & IC at 20 & 40 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + imazethapyr @ 75 g/ha as POE at 20 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + HW & IC at 40 DAS and propaquizafop @ 90 g/ha as POE at 20 DAS + HW & IC at 40 DAS in most of the cases and lower content of N, P and K in pod and haulm were recorded under unweeded control (Table 1).

Effect on nutrient content in weeds

The unweeded control recorded significantly higher N, P and K content in weed, whereas significantly lower content of N, P and K in weed were recorded under HW & IC at 20 & 40 DAS, which remained statistically at par with application of pendimethalin 30% EC @ 0.900 kg/ha as PE + imazethapyr @ 75 g/ha as POE at 20 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + HW & IC at 40 DAS and propaquizafop @ 90 g/ha as POE at 20 DAS + HW & IC at 40 DAS (Table 4).

Effect on nutrient uptake by crop

N, P and K uptake by pod was significantly higher under weed free, which remained statistically at par with application of pendimethalin 30% EC @ 0.900 kg/ha as PE + imazethapyr @ 75 g/ha as POE at 20 DAS, HW & IC at 20 & 40 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + HW & IC at 40 DAS and propaquizafop @ 90 g/ha as POE at 20 DAS + HW & IC at 40 DAS. N, P and

K uptake by haulm was significantly higher under weed free, which remained statistically at par with application of HW & IC at 20 & 40 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + HW & IC at 40 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + imazethapyr @ 75 g/ha as POE at 20 DAS and propaquizafop @ 90 g/ha as POE at 20 DAS + HW at 40 DAS and significantly lower uptake of N, P and K by pod and haulm was recorded under unweeded control in most of the cases (Table 2).

N, P and K uptake by crop was significantly higher under weed free, which remained statistically at par with application of pendimethalin 30% EC @ 0.900 kg/ha as PE + imazethapyr @ 75 g/ha as POE at 20 DAS, HW & IC at 20 & 40 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + HW & IC at 40 DAS and propaquizafop @ 90 g/ha as POE at 20 DAS + HW & IC at 40 DAS and lower uptake of N, P and K by crop was noted under unweeded control (Table 3). The results are in close agreements with the findings of Singh and Gajendra (2001), Kumar and Rana (2004), Savu *et al.* (2005) and Sharma *et al.* (2005).

Effect on nutrient uptake by weeds

Significantly the highest uptake of N, P and K by weeds was recorded under unweeded control. Except weed free, significantly lower uptake of N, P and K by weeds was recorded with HW & IC at 20 & 40 DAS, which remained statistically at par with application of pendimethalin 30% EC @ 0.900 kg/ha as PE + imazethapyr @ 75 g/ha as POE at 20 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + HW & IC at 40 DAS and propaquizafop @ 90 g/ha as POE at 20 DAS + HW & IC at 40 DAS (Table 3).

Higher photosynthetic activity in plant as evident from increase in

biomass accumulation at successive duration and plant height reveals higher availability of metabolites from shoot to root. This might have promoted growth of root as well as their functional activity resulting in higher extraction of nutrients from soil environment to aerial parts. The nutrient uptake is a function of yield and nutrient concentrations in plant. Thus, significant improvement in uptake of N, P and K might be attributed to their respective higher concentration in pod and haulm and associated with higher pod and haulm yield. This might also be attributed to better availability of nutrients in the soil under these treatments. The results of present investigation are in close agreements with the findings of Yadav *et al.* (1986), Patel *et al.* (1991), Kundra *et al.* (1993), Devakumar and Giri (1999), Madhu *et al.* (2006) and Chaudhari *et al.* (2007).

Effect on quality parameters

Quality parameters viz., protein and oil content in kernel were significantly influenced by different weed management practices. Significantly higher protein content in kernel and oil content in kernel were recorded under weed free, which remained statistically at par with HW & IC at 20 & 40 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + imazethapyr @ 75 g/ha as POE at 20 DAS, pendimethalin 30% EC @ 0.900 kg/ha as PE + HW & IC at 40 DAS and propaquizafop @ 90 g/ha as POE at 20 DAS + HW at 40 DAS and significantly the lowest values of protein content and oil per cent in kernel were recorded under unweeded control (Table 4).

Significant improvement in kernel protein content might be due to its dependence on nitrogen content. In the present investigation, higher nitrogen content in kernel and subsequently

higher nitrogen uptake by pod were recorded with the above mentioned treatments that lend support to enhance protein content under the effect. Weed free condition under the above mentioned treatments provided favourable condition to root and pod development due to efficient control of weeds which also influenced nutrient uptake of soil which might help to increase protein content and oil per cent in kernel. The lowest protein content and oil per cent in kernel under unweeded control can be ascribed to severe competition by weeds might have resulted in lower uptake of nutrients, which adversely affected the protein and oil synthesis. The results are on line with those of Thorat *et al.* (2004), Vala (2005), Zid (2006), Chhatrala (2006), Sardana *et al.* (2006), Singh and Singh (2009) and Daki (2012).

CONCLUSION

Based on the pooled results of two-year experimentation, it is concluded that higher uptake of nutrients and quality production along with efficient weed management in *kharif* groundnut under South Saurashtra Agro-climatic Zone can be achieved by either HW & IC at 20 & 40 DAS or pendimethalin 30% EC @ 0.900 kg/ha as PE + imazethapyr @ 75 g/ha as POE at 20 DAS or pendimethalin 30% EC @ 0.900 kg/ha as PE + HW & IC at 40 DAS or propaquizafop @ 90 g/ha as POE at 20 DAS + HW & IC at 40 DAS according to availability of labourers.

REFERENCES

- Chaudhari, A. P.; Gaikwad, C. B.; Tiwari, T. K.; Nikam, A. S.; Bhende, S. N. and Bagwan, I. R. (2007). Effect of weed control on nutrient uptake, weed weight and yield of groundnut. *International J. Agril. Sci.*, 3(1): 193-195.

- Chhatrala, M. R. (2005). Efficacy of various herbicides and determination of their persistence through bioassay technique for *kharif* groundnut. M.Sc. (Agri.) thesis (unpublished) submitted to Junagadh Agricultural University, Junagadh (Gujarat).
- Daki, R. N. (2012). Efficacy of new herbicides in summer groundnut (*Arachis hypogaea* L.) under south Saurashtra condition. M.Sc. (Agri.) thesis (unpublished) submitted to Junagadh Agricultural University, Junagadh (Gujarat).
- Devakumar, M. and Giri, G. (1999). Effect of weed control and gypsum application on uptake of N, P, K, Ca and S by groundnut (*Arachis hypogaea* L.) and weeds. *Indian J. Agron.*, **44**(2): 400-403.
- DOA, (2012). "District wise Area, Production and Yield per Hectare of groundnut Crop in Gujarat State 2012". Directorate of Agriculture, Gujarat State, Government of Gujarat, Gandhinagar.
- DOAC (2012). Directorate of Economics and Statistics, Directorate of Agriculture and Cooperation, Government of India, New Delhi.
- Jackson, M. L. (1974). "Soil Chemical Analysis". Prentice Hall of India Pvt. Ltd., New Delhi, pp. 327-350.
- Kumar, A. and Rana, D. S. (2004). Effect of land configuration and weed management on weed suppression, nutrient depletion by weeds, yield and quality of rainy season groundnut (*Arachis hypogaea* L.). *Indian J. Agril. Sci.*, **74**(12): 680-682.
- Kundra, H. C.; Singh, G. and Brar, C. S. (1993). Nutrient uptake by pea and associated weeds under different weed management practices. Procurement Symposium. *Indian Society of Weed Science*, Hisar, II: 49-51.
- Madhu, S. C.; Mudalagiriappa; Pujari, B. T. and Somasekhar. (2006). Effect of integrated weed management on nutrient uptake and yield in groundnut and sunflower intercropping system. *Karnataka J. Agril. Sci.*, **19**(1): 5-8.
- Madhusudhana, B. (2013). A Survey on Area, Production and Productivity of Groundnut Crop in India, *IOSR J. Econ. Fin.*, **1**(3): 01-07.
- Mehrotra, N. (2011), Commodity Specific Study: Groundnut, NABARD, Mumbai.
- Olsen, S. R.; Cole, V. C.; Watanable, F. S. and Dean, L. A. (1954). "Estimation of available phosphorus in soil by extraction with sodium bicarbonate". USDA, Circular No. 939, US Govt. Printing Office, Washington DC.
- Patel, M. P.; Shelke, V. B. and Patel, H. S. (1991). Economics of pre-monsoon groundnut as influenced by weed management and phosphorus application. *GAU Res. J.*, **17**(1): 1-4.
- Sardana, V.; Walia, U. S. and Kandhola, S. S. (2006). Productivity and economics of summer groundnut (*Arachis hypogaea* L.) cultivation as influenced by weed management practices. *Indian J. Weed Sci.*, **38**(1&2): 156-158.
- Savu, R. M.; Choubey, N. K.; Shrivastava, G. K. and Tiwari,

- N. (2005). Effect of chemical weed control on nitrogen uptake, weed weight and yield of groundnut under Chhattisgarh plains. *Environ. Ecol.*, **23**(3): 400-402.
- Sharma, R.; Singh, P. and Sharma, R. P. (2005). Effect of weed and phosphorus management on weed dynamics, yield, quality and crop weed competition for nutrients in groundnut. *Haryana J. Agron.*, **21**(1): 65-66.
- Singh, H. and Singh, S. (2009). Weed management and soil micro-organisms studies in irrigated summer groundnut. *Indian J. Weed Sci.*, **41**(1&2): 103- 107.
- Singh, V. B. and Gajendra, G. (2001). Influence of intercropping and weed control measures on dry matter accumulation and nutrient uptake by sunflower (*Helianthus annuus*) and groundnut (*Arachis hypogaea* L.) and their effect on succeeding maize (*Zea mays*). *Indian J. Agron.*, **46**(1): 50-55.
- Subbaiah, B. V. and Asija, G. L. (1956). A rapid procedure for the estimation of available nitrogen in soil. *Curr. Sci.*, **25**(7): 259-260.
- Thorat, S. T. (2004). Effect of irrigation regimes, weed management and growth regulators on protein and dry pod yields of groundnut grown under polythene mulch. *International Arachis Newsl.*, **24**: 45-47.
- Vala, G. R. (2005). Efficacy of various herbicides and determination of their persistence through bioassay technique for summer Groundnut (*Arachis hypogaea* L.). Ph.D. (Agri.) thesis (unpublished) submitted to Junagadh Agricultural University, Junagadh (Gujarat).
- Yadav, S. K.; Bhan, V. M. and Kumar, A. (1986). Studies on removal of nutrients by weeds and their control in groundnut. *Indian J. Agron.*, **31**(2): 177-181.
- Zid, M. Z. (2006). Efficacy of z in pre-monsoon groundnut (*Arachis hypogaea* L.). M.Sc. (Agri.) thesis (unpublished) submitted to Junagadh Agricultural University, Junagadh (Gujarat).

**Table 1: Effect of different treatments on nutrient content in pod and haulm
(Pooled over two years)**

Treatments	Nutrient Content in pod			Nutrient Content in Haulm		
	N	P	K	N	P	K
T ₁ = Pendimethalin 30% EC @ 0.900 kg/ha PE + HW & IC at 40 DAS	1.124	0.247	1.064	1.350	0.227	1.029
T ₂ = Pendimethalin 38.7% CS @ 0.750 kg/ha PPI + HW & IC at 40 DAS	1.081	0.238	1.082	1.339	0.207	0.909
T ₃ = Oxyfluorfen @ 0.240 kg/ha PE + HW & IC at 40 DAS	1.053	0.225	1.035	1.339	0.205	0.905
T ₄ = Quizalofop-ethyl @ 40 g/ha POE at 20 DAS + HW & IC at 40 DAS	1.056	0.232	1.040	1.353	0.217	0.973
T ₅ = Pendimethalin 30% EC @ 0.900 kg/ha PE + Quizalofop-ethyl @ 40 g/ha POE at 20 DAS	1.080	0.241	1.093	1.396	0.235	1.046
T ₆ = Imazethapyr @ 75 g/ha POE at 20 DAS + HW & IC at 40 DAS	1.061	0.225	1.062	1.321	0.208	0.909
T ₇ = Pendimethalin 30% EC @ 0.900 kg/ha PE + Imazethapyr @ 75 g/ha POE at 20 DAS	1.127	0.271	1.113	1.477	0.263	1.133
T ₈ = Oxadiargyl @ 90 g/ha POE at 20 DAS + HW & IC at 40 DAS	1.036	0.210	1.022	1.265	0.192	0.885
T ₉ = Propaquizafop @ 90 g/ha POE at 20 DAS + HW & IC at 40 DAS	1.098	0.263	1.078	1.473	0.259	1.129
T ₁₀ = HW & IC at 20 & 40 DAS	1.131	0.240	1.072	1.351	0.228	1.050
T ₁₁ = Weed Free	1.146	0.285	1.141	1.606	0.270	1.141
T ₁₂ = Unweeded control	0.839	0.174	0.809	0.949	0.162	0.742
S.Em.±	0.01	0.008	0.028	0.054	0.007	0.028
C.D. (P=0.05)	0.03	0.022	0.078	0.155	0.020	0.088
C.V. (%)	2.59	7.97	6.41	9.82	7.86	3.79

Table 2: Effect of different treatments on nutrient uptake by pod and haulm (Pooled over two years)

Treatments	Nutrient Uptake by Pod			Nutrient Uptake by Haulm		
	N	P	K	N	P	K
T ₁ = Pendimethalin 30% EC @ 0.900 kg/ha PE + HW & IC at 40 DAS	18.23	3.490	15.04	31.46	5.34	24.29
T ₂ = Pendimethalin 38.7% CS @ 0.750 kg/ha PPI + HW & IC at 40 DAS	14.88	3.284	14.88	31.29	4.78	21.05
T ₃ = Oxyfluorfen @ 0.240 kg/ha PE + HW & IC at 40 DAS	14.24	3.044	13.98	29.62	4.58	20.17
T ₄ = Quizalofop-ethyl @ 40 g/ha POE at 20 DAS + HW & IC at 40 DAS	15.69	3.402	15.27	31.26	4.98	22.37
T ₅ = Pendimethalin 30% EC @ 0.900 kg/ha PE + Quizalofop-ethyl @ 40 g/ha POE at 20 DAS	16.39	3.634	16.49	34.38	5.67	25.31
T ₆ = Imazethapyr @ 75 g/ha POE at 20 DAS + HW & IC at 40 DAS	15.44	3.267	15.44	29.83	4.69	20.54
T ₇ = Pendimethalin 30% EC @ 0.900 kg/ha PE + Imazethapyr @ 75 g/ha POE at 20 DAS	18.39	4.430	18.22	36.81	6.54	28.21
T ₈ = Oxadiargyl @ 90 g/ha POE at 20 DAS + HW & IC at 40 DAS	13.47	2.686	13.09	27.05	4.14	19.11
T ₉ = Propaquizafop @ 90 g/ha POE at 20 DAS + HW & IC at 40 DAS	17.52	4.131	16.77	35.82	6.33	27.58
T ₁₀ = HW & IC at 20 & 40 DAS	18.13	3.467	15.51	31.55	5.33	24.54
T ₁₁ = Weed Free	19.51	4.825	19.30	41.56	6.99	29.57
T ₁₂ = Unweeded control	7.07	1.459	6.75	12.03	2.06	9.46
S.Em.±	0.46	0.159	0.51	1.64	0.18	0.61
C.D. (P=0.05)	1.32	0.453	1.47	4.67	0.50	1.74
C.V. (%)	7.17	11.35	8.37	12.90	8.47	6.59

**Table 3: Effect of different treatments on uptake by crop and weeds
(Pooled over two years)**

Treatments	Uptake by Crop			Uptake by Weeds		
	N	P	K	N	P	K
T ₁ = Pendimethalin 30% EC @ 0.900 kg/ha PE + HW & IC at 40 DAS	46.42	8.83	39.34	14.99	1.087	2.670
T ₂ = Pendimethalin 38.7% CS @ 0.750 kg/ha PPI + HW & IC at 40 DAS	46.15	8.07	35.93	19.19	1.615	5.805
T ₃ = Oxyfluorfen @ 0.240 kg/ha PE + HW & IC at 40 DAS	43.52	7.62	34.15	21.61	2.102	6.325
T ₄ = Quizalofop-ethyl @ 40 g/ha POE at 20 DAS + HW & IC at 40 DAS	46.75	8.38	37.65	16.13	1.174	3.055
T ₅ = Pendimethalin 30% EC @ 0.900 kg/ha PE + Quizalofop-ethyl @ 40 g/ha POE at 20 DAS	50.98	9.30	41.80	14.27	0.928	2.215
T ₆ = Imazethapyr @ 75 g/ha POE at 20 DAS + HW & IC at 40 DAS	45.34	7.96	35.98	17.13	1.490	3.655
T ₇ = Pendimethalin 30% EC @ 0.900 kg/ha PE + Imazethapyr @ 75 g/ha POE at 20 DAS	55.72	10.97	46.43	8.85	0.659	1.806
T ₈ = Oxadiargyl @ 90 g/ha POE at 20 DAS + HW & IC at 40 DAS	40.54	6.83	32.19	23.06	2.108	6.253
T ₉ = Propaquizafop @ 90 g/ha POE at 20 DAS + HW & IC at 40 DAS	53.81	10.46	44.35	9.57	0.888	2.223
T ₁₀ = HW & IC at 20 & 40 DAS	46.93	8.80	40.05	13.06	0.958	2.112
T ₁₁ = Weed Free	61.27	11.81	48.86	0.00	0.000	0.000
T ₁₂ = Unweeded control	19.98	3.52	16.21	69.77	5.562	14.77
S.Em.+	1.69	0.25	0.81	0.79	0.08	0.23
C.D. (P=0.05)	4.82	0.71	2.32	2.25	0.23	0.65
C.V. (%)	8.91	7.17	5.28	10.20	12.67	13.25

Table 4: Different treatments on nutrient content in weeds and quality parameters (Pooled over two years)

Treatments	Nutrient Content in Weeds			Quality Parameters	
	N	P	K	Protein Content	Oil (%)
T ₁ = Pendimethalin 30% EC @ 0.900 kg/ha PE + HW & IC at 40 DAS	1.503	0.109	0.268	26.33	48.00
T ₂ = Pendimethalin 38.7% CS @ 0.750 kg/ha PPI + HW & IC at 40 DAS	1.430	0.140	0.432	25.78	46.26
T ₃ = Oxyfluorfen @ 0.240 kg/ha PE + HW & IC at 40 DAS	1.506	0.148	0.434	25.73	44.52
T ₄ = Quizalofop-ethyl @ 40 g/ha POE at 20 DAS + HW & IC at 40 DAS	1.577	0.130	0.311	26.00	45.81
T ₅ = Pendimethalin 30% EC @ 0.900 kg/ha PE + Quizalofop-ethyl @ 40 g/ha POE at 20 DAS	1.533	0.100	0.239	25.84	46.86
T ₆ = Imazethapyr @ 75 g/ha POE at 20 DAS + HW & IC at 40 DAS	1.487	0.128	0.318	26.00	46.18
T ₇ = Pendimethalin 30% EC @ 0.900 kg/ha PE + Imazethapyr @ 75 g/ha POE at 20 DAS	1.090	0.081	0.223	26.45	48.02
T ₈ = Oxadiargyl @ 90 g/ha POE at 20 DAS + HW & IC at 40 DAS	1.635	0.153	0.443	25.43	43.95
T ₉ = Propaquizafop @ 90 g/ha POE at 20 DAS + HW & IC at 40 DAS	1.077	0.097	0.231	26.20	47.98
T ₁₀ = HW & IC at 20 & 40 DAS	1.477	0.108	0.245	26.44	48.09
T ₁₁ = Weed Free	0.000	0.000	0.000	26.67	49.44
T ₁₂ = Unweeded control	2.233	0.171	0.472	24.00	40.12
S.Em. +	0.066	0.01	0.01	0.18	0.55
C.D. (P=0.05)	0.19	0.02	0.02	0.51	1.58
C.V. (%)	11.73	12.97	6.76	7.19	2.93

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