

Bio-Efficacy and Phytotoxicity Evaluation of Quizalofop-Ethyl (5% EC) for Management of Weeds in Onion

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ABSTRACT

A field experiment was conducted at Agricultural Research Station, Bhavanisagar of Tamil Nadu Agricultural University, during *rabi* 2012-13. Twelve treatments viz., early post-emergence application of new formulation of quizalofop-ethyl at 37.5 (T₁), 50 (T₂), 75 (T₃) and 100 (T₄) g a.i ha⁻¹, already registered early post-emergence herbicide quizalofop-ethyl (Targa super) at 37.5 (T₅) and 50 (T₆) g a.i ha⁻¹, pendimethalin at 1.0 kg a.i ha⁻¹ + Hand Weeding on 45 DAT (T₇), pendimethalin at 1.0 kg a.i ha⁻¹ + Mechanical Weeding on 45 DAT (T₈), oxyfluorfen at 0.2 kg a.i ha⁻¹ + Hand Weeding on 45 DAT (T₉), oxyfluorfen at 0.2 kg a.i ha⁻¹ + Mechanical Weeding on 45 DAT (T₁₀), Hand Weeding on 25 and 45 DAT (T₁₁) and unweeded check (T₁₂) were laid out in randomized block design with three replications. Grasses was predominantly found in the experimental field. Lower density of grasses was recorded under early post emergence application of quizalofop-ethyl at 100 and 75 g a.i ha⁻¹ due to control of emerged as well as emerging grass weeds. Control of weeds during the critical period of crop weed competition by early post-emergence application of new molecule of quizalofop-ethyl at 75 g a.i ha⁻¹ led to better plant growth, effective utilization of nutrients and higher dry matter production which resulted in increase in yield and was comparable with pre-emergence application of oxyfluorfen at 0.2 a.i kg ha⁻¹ + hand weeding on 45 DAT and oxyfluorfen at 0.2 kg a.i ha⁻¹ + mechanical weeding on 45 DAT.

Key words Bio-Efficacy, Phytotoxicity Evaluation, Quizalofop-Ethyl, Management, Weeds, Onion

Food from natural origin plays a significant role in the health care system of all our human

beings. Cereals, pulses, oilseeds, fruits and vegetables are the major source of food materials that we consume. Among vegetables, onion occupies a prominent place and it forms an indispensable part of many diets, both vegetarian and non-vegetarian. It is also known as Queen of kitchen. The productivity of onion in India is very less when compared with the world average productivity. Onion exhibits greater susceptibility to weed competition as compared to other crops due to its inherent characteristics such as their slow growth, small stature, shallow roots and lack of dense foliage (Ware and McCollum, 1975). This favors quick and fast growth of weeds in the initial stages leading to severe competition. Hand weeding in onion is a common practice in India, but it is a tedious, expensive and time consuming task due to closer spacing and shallow root system. Non-availability of labourers during critical period of crop makes hand weeding difficult leading to heavy yield losses. Spraying of pre-emergence herbicides keeps the crop in weed free conditions during the early stages. At later stage, second flush of weeds will affect the bulb formation. Pre-emergence herbicide combined with hand weeding may be costly because of the reduced labour availability and higher labour cost. After bulb formation manual or mechanical methods of weed control will damage the bulb. Hence, application of early post-emergence may be helpful to reduce damage to the bulb, weed competition and cost of weeding. Newer formulations of herbicides are available in the market with wide spectrum of weed control efficiency. These new herbicide formulations are to be evaluated for their bio-efficacy of controlling a wide range of weed flora, better crop growth and yield.

Table 1. Effect of weed management methods on density of *Echinochloa colonum*, total grasses, sedges and broad leaved weeds at 40 DAT

Treatments		Density of <i>Echinochloa</i> <i>colonum</i> (No. m ⁻²)	Density of total grasses (No. m ⁻²)	Density of total sedges (No. m ⁻²)	Density of total broad leaved weeds (No. m ⁻²)
T ₁	EPOE Quizalofop-ethyl 5% EC at 37.5 g a.i ha ⁻¹	5.86 (32.35)	7.75 (58.38)	5.13 (24.60)	5.90 (33.18)
T ₂	EPOE Quizalofop-ethyl 5% EC at 50 g a.i ha ⁻¹	5.31 (26.41)	6.33 (38.05)	5.12 (24.26)	5.89 (32.85)
T ₃	EPOE Quizalofop-ethyl 5% EC at 75 g a.i ha ⁻¹	3.90 (13.48)	3.98 (13.83)	4.93 (22.38)	5.98 (33.84)
T ₄	EPOE Quizalofop-ethyl 5% EC at 100 g a.i ha ⁻¹	3.45 (10.18)	3.54 (10.57)	4.83 (21.35)	5.87 (32.51)
T ₅	EPOE Quizalofop-ethyl 5% EC (TS) at 37.5 g a.i ha ⁻¹	6.06 (34.77)	7.87 (60.04)	5.11 (24.21)	5.95 (33.51)
T ₆	EPOE Quizalofop-ethyl 5% EC (TS) at 50 g a.i ha ⁻¹	5.29 (25.99)	6.51 (40.34)	5.05 (23.73)	5.83 (32.18)
T ₇	PE Pendimethalin at 1.0 kg a.i ha ⁻¹ + HW on 45 DAT	6.11 (35.47)	6.89 (45.55)	4.32 (16.71)	4.99 (22.86)
T ₈	PE Oxyfluorfen at 0.2 kg a.i ha ⁻¹ + HW on 45 DAT	5.51 (28.54)	6.87 (45.22)	4.19 (15.60)	4.68 (19.95)
T ₉	PE Pendimethalin at 1.0 kg a.i ha ⁻¹ + MW on 45 DAT	5.88 (32.67)	6.94 (46.22)	4.41 (17.60)	4.95 (22.53)
T ₁₀	PE Oxyfluorfen at 0.2 kg a.i ha ⁻¹ + MW on 45 DAT	5.50 (28.34)	6.92 (45.89)	4.03 (14.26)	4.61 (19.29)
T ₁₁	Hand weeding on 25 and 45 DAT	4.72 (20.30)	5.19 (25.20)	3.35 (9.33)	4.30 (16.53)
T ₁₂	Unweeded control	13.69 (185.67)	14.94 (221.33)	5.27 (25.74)	5.99 (33.90)
Sed		0.22	0.29	0.31	0.28
CD (P=0.05)		0.56	0.60	0.63	0.59

Figures in the paranthesis are original values

TS -Targa Super

HW -Hand Weeding

MW -Mechanical Weeding

MATERIALS AND METHODS

A field experiment was conducted at Agricultural Research Station, Bhavanisagar of Tamil Nadu Agricultural University, during *rabi* 2012-13. Twelve treatments *viz.*, early post-emergence application of new formulation of quizalofop-ethyl at 37.5 (T₁), 50 (T₂), 75 (T₃) and 100 (T₄) g a.i ha⁻¹, already registered early post-emergence herbicide quizalofop-ethyl (Targa super) at 37.5 (T₅) and 50 (T₆) g a.i ha⁻¹, pendimethalin at 1.0 kg a.i ha⁻¹ + Hand Weeding on 45 DAT (T₇), pendimethalin at 1.0 kg a.i ha⁻¹ + Mechanical

Weeding on 45 DAT (T₈), oxyfluorfen at 0.2 kg a.i ha⁻¹ + Hand Weeding on 45 DAT (T₉), oxyfluorfen at 0.2 kg a.i ha⁻¹ + Mechanical Weeding on 45 DAT (T₁₀), Hand Weeding on 25 and 45 DAT (T₁₁) and unweeded check (T₁₂) were laid out in randomized block design with three replications. Onion variety CO (On) 5 was transplanted at 45 x 10 cm in ridges and furrows. Onion variety Co (On) 5 was transplanted by raising nursery. The crop was fertilized with the recommended dose of 60:60:30 kg NPK ha⁻¹. Data were collected on weed density, weed dry weight, phytotoxicity rating, dry matter production, yield and weed index.

Table 2. Phytotoxic effect, dry matter production and bulb yield of onion influenced by weed management methods.

Treatments		3 DAHS	7 DAHS	15 DAHS	21 DAHS	Dry matter production (kg ha ⁻¹) 60 DAT	Bulb yield (kg ha ⁻¹)
T ₁	- EPOE Quizalofop-ethyl 5% EC at 37.5 g a.i ha ⁻¹	0	0	0	0	761	9704
T ₂	- EPOE Quizalofop-ethyl 5% EC at 50 g a.i ha ⁻¹	0	0	0	0	809	10388
T ₃	- EPOE Quizalofop-ethyl 5% EC at 75 g a.i ha ⁻¹	0	0	0	0	853	13055
T ₄	- EPOE Quizalofop-ethyl 5% EC at 100 g a.i ha ⁻¹	3	2	0	0	798	9972
T ₅	- EPOE Quizalofop-ethyl 5% EC (TS) at 37.5 g a.i ha ⁻¹	0	0	0	0	740	9633
T ₆	- EPOE Quizalofop-ethyl 5% EC (TS) at 50 g a.i ha ⁻¹	0	0	0	0	800	10355
T ₇	- PE Pendimethalin at 1.0 kg a.i ha ⁻¹ + HW on 45 DAT	0	0	0	0	810	11197
T ₈	- PE Oxyfluorfen at 0.2 kg a.i ha ⁻¹ + HW on 45 DAT	0	0	0	0	829	12858
T ₉	- PE Pendimethalin at 1.0 kg a.i ha ⁻¹ + MW on 45 DAT	0	0	0	0	807	10707
T ₁₀	- PE Oxyfluorfen at 0.2 kg a.i ha ⁻¹ + MW on 45 DAT	0	0	0	0	824	12681
T ₁₁	- Hand weeding on 25 and 45 DAT	0	0	0	0	815	11393
T ₁₂	- Unweeded control	0	0	0	0	401	4053
SEd		-	-	-	-	19	793
CD (P=0.05)		-	-	-	-	39	1657

Phytotoxicity rating data not statistically analysed TS - Targa Super HW - Hand Weeding MW - Mechanical Weeding
 DAHS – Days After Herbicide Spray

RESULT AND DISCUSSION

Predominant weed flora of the experimental field consisted of four species of grasses namely *Brachiaria reptans*, *Chloris barbata*, *Digitaria bicornis*, *Echinochloa colonum* and six species of broad leaved weeds namely *Eclipta prostrata*, *Euphorbia hirta*, *Portulaca oleracea*, *Stachytarpheta jamaicensis*, *Trianthema portulacastrum* and *Tridax procumbens*. The only sedge weed found in the experimental field was *Cyperus iria*. Significant variation in weed density was observed among the weed control treatments.

Early post-emergence application of new molecule of quizalofop-ethyl at 100 and 75 g a.i ha⁻¹ recorded lower density of *Echinochloa colonum*. This might be due to the inhibition of acetyl CoA carboxylase activity which is a key enzyme in photosynthetic pathway. Effectiveness of various herbicides against different weed species in onion has been earlier reported by Tripathi *et al.* (2008). Early post emergence application of quizalofop-ethyl at 100 and 75 g a.i ha⁻¹ registered lower density of grasses due to control of emerged as well as further emerging grass weeds. A similar finding

was reported by Ghorai *et al.* (2004). *Cyperus iria* was the only sedge found in the experimental field.

Pre-emergence application of oxyfluorfen at 0.2 kg a.i ha⁻¹ + hand weeding on 45 DAT recorded lower density of sedge at all the stages of observation. The sedge was not satisfactorily controlled by pre-emergence application of oxyfluorfen at 0.2 kg a.i ha⁻¹. The report of Singh and Gajendra Giri (2001) who found that pre-emergence application of oxyfluorfen and pendimethalin provided excellent control of annual broad leaved weeds but failed to elicit effect on sedges is in support of the present result. Lower density of broad leaved weeds was observed under pre-emergence application of oxyfluorfen at 0.2 kg a.i ha⁻¹ + hand weeding on 45 DAT at all the stages of observation. This might be due to broad spectrum activity of oxyfluorfen. Similar results was also reported by Sukhadia *et al.* (2002) who found that pre-emergence application of oxyfluorfen at 0.24 kg ha⁻¹ reduced the density of broad leaved weeds in onion compared with non treated plots.

The new molecule of early post-emergence application of quizalofop-ethyl at 100 g a.i ha⁻¹ showed phytotoxicity symptoms like leaf tip burn, leaf curling and stunted symptoms in onion due to increase in rate of herbicides which cause damage to crop plants. Channappagoudar and Biradar (2007) also reported that pre-emergence application of oxyfluorfen at 0.25 kg ha⁻¹ controlled weeds effectively but resulted in lower yield because of its higher phytotoxicity on onion crop and it was only for a short period.

Lesser crop weed competition with more conservation of soil moisture, nutrient and space for crop resulted in better vegetative growth and dry matter production of crop under effective weed control treatments. Control of weeds during the critical period of crop weed competition by early post-emergence application of new molecule of quizalofop-ethyl at 75 g a.i ha⁻¹ led to better plant growth, effective utilization of nutrients and higher dry matter production was comparable with pre-emergence application of oxyfluorfen at 0.2 a.i kg ha⁻¹ + hand weeding on 45 DAT and oxyfluorfen at

0.2 kg a.i ha⁻¹ + mechanical weeding on 45 DAT. Effective control of weeds during the critical stage of crop growth lead to efficient utilization of light, space, nutrients and water which results in increased dry matter production. Higher bulb yield (13,055 kg ha⁻¹) was obtained under early post-emergence application of new molecule of quizalofop-ethyl at 75 g a.i ha⁻¹ due to efficient control of weeds at critical stages resulting in least competition by weeds for nutrients providing favourable environment for growth and development of onion leading to increase in yield. This finding derives support from Patel *et al.* (2011) who also reported similar findings. Oxyfluorfen at 0.2 kg a.i ha⁻¹ + hand weeding on 45 DAT and oxyfluorfen at 0.2 kg a.i ha⁻¹ + mechanical weeding on 45 DAT was comparable with a bulb yield of 12858 kg ha⁻¹ and 12681 kg ha⁻¹, respectively. This might be due to efficient control of weeds in the early stage of crop growth by pre-emergence herbicides and at later stages by sequential weedings (manual or mechanical) which lead to better availability of moisture and nutrients. This result is in line with the findings of Ratnam *et al.* (2012). Yield obtained from hand weeded treatment was lower as compared to quizalofop-ethyl at 75 g a.i ha⁻¹, oxyfluorfen at 0.2 kg a.i ha⁻¹ + hand weeding on 45 DAT and oxyfluorfen at 0.2 kg a.i ha⁻¹ + mechanical weeding on 45 DAT due to disturbance of the shallow root system and damage to leaves which reduced the photosynthetic activity of the plants which was neither carried out nor only once in the best treatments. This finding is in conformity with the findings of Patel *et al.*, 2011.

Under grass dominated fields application of new formulation of quizalofop-ethyl (5% EC) at 75 g a.i ha⁻¹ (T₃) can lower the grass weed density in grass dominated fields during critical stage of the crop growth which in turn increase the bulb yield in onion.

ACKNOWLEDGEMENT

Dr. M. Mohamed Amanullah, Dr. C. Chinnusamy, Dr. P. Muthukrishnan, Dr. P. Murali Arthanari, Dr. K. Rajendran, Dr. K. Vaiyapuri, Dr. P. Janaki TNAU, Coimbatore. M/s. Crystal Phosphates Ltd, New Delhi

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Received on 15-03-2015

Accepted on 20-03-2015