International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 276-279

Received: 05-07-2018
Accepted: 10-08-2018

Shalini RM
Department of plantation, Spices, Medicinal and Aromatic crops, KRCCH Arabhavi, UHS, Bagalkot, Karnataka, India

Srikantaprasad D
Department of plantation, Spices, Medicinal and Aromatic crops, KRCCH Arabhavi, UHS, Bagalkot, Karnataka, India

Pushpa TN
Department of plantation, Spices, Medicinal and Aromatic crops, KRCCH Arabhavi, UHS, Bagalkot, Karnataka, India

Kantharaju V
ICAR-AICRP on Fruits, KRCCH Arabhavi, UHS, Bagalkot, Karnataka, India

Hanchinamani CN
Department of Vegetable Science, KRCCH Arabhavi, UHS, Bagalkot, Karnataka, India

Correspondence
Shalini RM
Department of plantation, Spices, Medicinal and Aromatic crops, KRCCH Arabhavi, UHS, Bagalkot, Karnataka, India

Chemical weed management in transplanted turmeric (*Curcuma longa* L.)

Shalini RM, Srikantaprasad D, Pushpa TN, Kantharaju V and Hanchinamani CN

Abstract
The study was conducted at KRCCH, Arabhavi during the year 2017-18 to study the effect of pre-emergent herbicides in transplanted turmeric. The experiment consisted of 10 herbicide treatments along with weed free check, unweeded control and polythene mulching. The experiment was laid out in randomized block design with three replications. The results revealed that all weed management methods significantly reduced the weed density and dry weight. Among the herbicides, significantly lower weed density and dry weight was recorded in application of Metribuzin 70% WP @ 1.05 kg a.i. ha^{-1} (8.00 m^{-2} and 9.33g m^{-2}, respectively) at 30 DAT. With respect to fresh rhizome yield, application of Oxyfluorfen 23.5% EC @ 0.3 kg a.i. ha^{-1} recorded the highest yield (8.04 kg $plot^{-1}$) as compared to the other post planting pre-emergent herbicides.

Keywords: pre-emergent, herbicides, weed density, mulch

Introduction
Turmeric, the dried rhizome of the herbaceous perennial *Curcuma longa* L. (Zingiberaceae) is a commercially important sacred spice of India. It is a crop of warm-humid climate native of South Asia, particularly India (Mannikeri, 2006) [11]. The successful cultivation of the crop mainly depends upon weed management as the loss due to weed is estimated to be 30 to 75 per cent owing to delayed emergence, slow initial growth, poor crop canopy development and long duration. The cost of planting material involves 40 per cent of the total cost of cultivation due to very high seed rate. Addressing this, alternative method of raising turmeric seedlings in protrays by using rhizome cuttings is demonstrated (Bhanumurthy *et al*., 2018; Malhotra *et al*., 2016) [2, 10], which is accepted by progressive farmers of the study area too. Conventional weed management practices are costly, unavailable in time and exhaustive due to different back pulling reasons especially in transplanted turmeric. Besides, such weed control practices are also often turned into uncertainty due to interference of rains. In this context, herbicides offer ample scope to bridge the gaps. As far as, the environment and health are concerned, herbicides are not aimed at substituting the traditional practices and they are only considered as additional production tools in crop production. Residual effect of chemicals is now of great concern. In order to reduce the risk of persistence of chemical residues, application of pre-emergent herbicides is gaining importance.

Materials and Methods
The study was conducted at the Department of Plantation, Spices, Medicinal and Aromatic crops, K R C College of Horticulture, Arabhavi, during 2017-18. The experiment was laid out in a randomized complete block design with 13 treatments (hand weeding at 15 days interval upto 3 months, Pre-emergent herbicides *viz.*, Alachlor 50% EC @ 1 and 1.5 kg a.i ha^{-1}, Atrazine 50% WP@ 1 and 1.5 kg a.i ha^{-1}, Metribuzin 70% WP @ 0.7 and 1.05 kg a.i ha^{-1}, Oxyfluorfen 23.5% EC @ 0.2 and 0.3 kg a.i ha^{-1} and Pendimethalin 30% EC @ 1 and 1.5 kg a.i ha^{-1}, 30 µ silver black polythene mulch and unweeded control) and replicated thrice. The experimental site was brought to fine tilth, laid out in to plots of 3.6 m width and 4.5 m length followed by preparation of 90 cm wide beds raised 15 cm height. The experiment site was applied with farm yard manure (25 t ha^{-1}) along with 75: 125: 250 kg N, P_2O_5 and K_2O ha^{-1} during land preparation. Additional 75 kg N ha^{-1} was applied as top dressing at 45 days after transplanting. Two month old healthy and uniform plantlets were transplanted at 45*30 cm spacing on the beds, irrigated immediately and applied with pre-emergent herbicides according to treatments as directed sprays without deliberately spraying on the transplanted turmeric plants using knapsack sprayer fitted with flood-jet type nozzle. Subsequent irrigations were

given through drip at daily intervals. Irrigation was withheld fifteen days before harvesting. The crop was harvested by digging out the rhizome at complete maturity as indicated by withering and drying up of leaves and tillers. Harvested rhizomes were cleaned to remove adhering soil and attached roots and dried in shade. The species-wise number of weeds were counted from randomly selected spots (100 cm × 100 cm quadrant) in each plot. Count and dry weights of weeds were taken at 30, 45, 60, 90 and 180 DAT from randomly selected spots (100 cm × 100 cm quadrants) in each plot. The weed samples were collected in separate paper bags and were dried in oven at 60°C till constant weight. The collected data were subjected to Fisher method of analysis of variance and interpreted at P = 0.05. The data on weed density and dry weight have shown high degree of variation, therefore subjected to square root transformation ($\sqrt{x+0.5}$).

Result and Discussion

Weed flora

The important monocotyledon weeds observed in the experimental area were *Cynodon dactylon*, *Dinebra retroflexa* and *Cyperus rotundus*. While, the common dicotyledon weeds were *Abutilon indicum*, *Acanthospermum hispidum*, *Ageratum conyzoides*, *Alternenthera sessilis*, *Amaranthus viridis*, *Euphorbia sp*., *Helicabamum cardiospurmum*, *Ipomea sp*., *Mimosa pudica*, *Parthenium hysterophorus*, *Phyllanthus urinaria*, *Portulaca oleraceae*, *Psoralea corylifolia*, *Triumfetta rhomboida*, *Vernonia cinerea* etc. The diversity of weed in the experimental site was high as it is located in command area of Ghatprabha left bank canal and irrigated atleast eight months in a year. The result is in line with the finding of Murthy (1950) who observed 57 different weed species in black cotton soils of Dharwad and Krishnamurthy (1957) [8] who listed as many as 203 weed species that are commonly found in cultivated fields of Karnataka.

Number of days taken for weed emergence

The weed emergence was observed in unweeded control after 9.00 days of herbicide application. While, the application of Metribuzin 70% WP @ 1.05 kg a.i. ha^{-1} delayed it up to 45 days, which was *on par* with Metribuzin 70% @ WP 0.7 kg a.i. ha^{-1} (42.33 days) attributing to its dual role of pre-emergent and early post-emergent herbicidal action by inhibiting photosystem II of photosynthesis disrupting electron transfer and resulting in death of target plant by starvation (Desai, 2017) [4]. Among the herbicides Alachlor 50% EC @ 1 kg a.i. ha^{-1} recorded the shortest periooid of protection against weed emergence (29.67 days).

Weed density

The lowest weed density (number m^{-2}) among the treatments was recorded in polythene mulching (3.33, 4.33, 4.67, 5.00 and 5.00 m^{-2} at 30, 45, 60, 90 and 180 DAT, respectively) as against the highest in unweeded control (35.33, 40.00, 42.00, 55.67 and 34.33 m^{-2}, respectively). Among the herbicides, significantly lower number of weeds was recorded with Metribuzin 70% WP @ 1.05 kg a.i. ha^{-1} (8.00, 12.33, 13.67, 19.00 and 13.67 m^{-2}, respectively) as compared to other post-planting pre-emergent herbicides. The lowest weed density in polythene mulch is due to unavailability of light required for germination and establishment. Further, under mulch the temperature would be three to five degree celcius lesser slowing down or halting the germination of weeds (Lamont, 2005) [9]. It was also evident that the recorded weeds in polythene mulch were mostly emerged where the soil was not covered in places such as inter row spaces between two mulch sheets and the holes made to plant turmeric. The *Cyperus rotundus* was an exception which was spearing out from the mulch sheet too. Dvorak *et al*. (2012) [5] and Azad *et al*. (2015) [1] also reported reduced weed density and diversity due to decline in light reaching weed canopy as major portion was absorbed either by crop or by mulch. Among the pre-emergent herbicides, application of Metribuzin at both the concentrations (Metribuzin 70% WP @ 0.7 and 1.05 kg a.i. ha^{-1}) significantly reduced the weed population as compared to other treatments owing to its broad spectrum action. Similar results were also reported by Gill *et al*. (2000) in turmeric, Mukherjee *et al.* (2012) [12], Jaiswal and Grewal (1991) [7] in potato.

Dry weight of weeds

Unweeded control recorded the maximum weed dry weight (62.00, 535.00, 772.67, 1409.33 and 2736.67 g m^{-2} at 30, 45, 60, 90 and 180 DAT, respectively) and the minimum in mulching (2.67, 2.93, 3.13, 3.43 and 4.43 g m^{-2}, respectively) as that of weed density. Among herbicides, application of Metribuzin 70% WP @ 1.05 kg a.i. ha^{-1} recorded significantly minimum dry weight of weeds at all the stages (9.33, 66.33, 126.67, 165.00 and 615.67 g m^{-2}, respectively). Wherever the weeds were controlled in early stages, the weed dry weight was also reduced. Even though the weeds emerged after the herbicidal effect was reduced, they were smothered by crop as shown by Dworak *et al*. (2012) and Azad *et al*. (2015) [1] and the reduced weed dry weight was recorded in comparison with unweeded check. As Metribuzin prevented weed seed germination and affected the photosynthesis in later stages, it recorded minimum weed dry weight among the herbicidal treatments. The results are in conformity with those reported by Gill *et al*. (2000) in turmeric, Mukherjee *et al.* (2012) [12] and Jaiswal and Grewal (1991) [7] in potato.

Fresh yield of Rhizome

The fresh rhizome yield per plot was significantly highest in mulching with polythene (12.61 kg plot^{-1}) which was statistically *on par* with hand weeding (11.27 kg plot^{-1}) whereas, the lowest fresh yield was recorded in unweeded control (2.27 kg plot^{-1}). There was 11.78 per cent increase in yield with application of polythene mulch as compared to weed free check due to less weed infestation, less fluctuation in soil moisture, preservation of organic carbon due to low temperature, enhanced microbial activity and enhanced availability of nutrients as opined by Thankamani *et al*. (2016) [16]. Among the herbicides, significantly higher fresh rhizome yield was obtained with application of Oxyfluorfen 23.5% EC @ 0.3 kg a.i. ha^{-1} (8.04 kg plot^{-1}) as compared to the other post planting pre-emergent herbicides. Earlier studies have also shown the superiority of Oxyfluorfen in onion by Sharma *et al*. (2009) and Ranpise and Patil (2001) and in ginger by Pillai (2015). Application of Metribuzin 70% WP @ 1.05 kg a.i. ha^{1} recorded lower yield (2.55 kg plot^{-1}) among the chemical treatments and it was *on par* with unweeded control. Even though application of Metribuzin effectively controlled the weeds, the performance of turmeric was non satisfactory. This might be due to its phytotoxic effect resulting in reduced photosynthesis and root penetration as reported by Pillai (2015) in ginger. The present result is in contrary to the findings of Gill *et al.* (2000) in turmeric who reported better yield with application of Metribuzin.

Table 1: Effect of weed management methods on number of days taken for weed emergence in transplanted turmeric

Treatments	Days after imposition
T_1 : Hand weeding (Weed free check)	11.33
T_2 : Alachlor 50% EC 1 kg a.i. ha^{-1}	29.67
T_3 : Alachlor 50% EC 1.5 kg a.i. ha^{-1}	31.33
T_4 : Atrazine 50% WP 1kg a.i. ha^{-1}	38.33
T_5 : Atrazine 50% WP 1.5 kg a.i. ha^{-1}	33.33
T_6 : Metribuzin 70% WP 0.7 kg a.i. ha^{-1}	42.33
T_7 : Metribuzin 70% WP 1.05 kg a.i. ha^{-1}	45.00
T_8 : Oxyfluorfen 23.5% EC 0.2 kg a.i. ha^{-1}	30.67
T_9 : Oxyfluorfen 23.5% EC 0.3 kg a.i. ha^{-1}	35.00
T_{10} : Pendimethalin 30% EC 1 kg a.i. ha^{-1}	32.33
T_{11} : Pendimethalin 30% EC 1.5 kg a.i. ha^{-1}	35.67
T_{13} : Unweeded control	9.00
S.Em±	1.52
CD at 5 %	4.45

Table 2: Effect of different weed management methods on weed density (number m^{-2}) in transplanted turmeric

Treatments	30 DAT	45 DAT	60 DAT	90 DAT	180 DAT
T_1: Hand weeding (Weed free check)	8.00(2.81)	9.00(3.00)	9.00(3.00)	9.33(3.05)	9.00(3.00)
T_2:Alachlor 50% EC @ 1 kg a.i. ha^{-1}	22.00(4.69)	24.00(4.90)	26.33(5.12)	35.00(5.91)	24.00(4.90)
T_3: Alachlor 50% EC @ 1.5 kg a.i. ha^{-1}	19.67(4.38)	23.33(4.82)	24.33(4.91)	34.00(5.83)	22.33(4.72)
T_4: Atrazine 50% WP @ 1kg a.i. ha^{-1}	19.67(4.43)	22.33(4.71)	24.33(4.92)	30.67(5.54)	22.33(4.72)
T_5:Atrazine 50% WP @ 1.5 kg a.i. ha^{-1}	18.33(4.28)	20.00(4.47)	23.67(4.86)	30.33(5.51)	18.00(4.24)
T_6: Metribuzin 70% WP @ 0.7 kg a.i. ha^{-1}	10.00(3.15)	13.00(3.59)	15.67(3.95)	19.33(4.40)	14.00(3.74)
T_7: Metribuzin 70% WP @ 1.05 kg a.i. ha^{-1}	8.00(2.81)	12.33(3.50)	13.67(3.69)	19.00(4.36)	13.67(3.69)
T_8: Oxyfluorfen 23.5% EC @ 0.2 kg a.i. ha^{-1}	18.33(4.27)	18.67(4.29)	21.33(4.60)	30.00(5.48)	19.33(4.40)
T_9:Oxyfluorfen 23.5% EC @ 0.3 kg a.i. ha^{-1}	16.33(4.00)	19.00(4.36)	22.00(4.68)	31.00(31.00)	18.00(4.24)
T_{10}: Pendimethalin 30% EC @ 1 kg a.i. ha^{-1}	15.67(3.95)	17.67(4.20)	21.33(4.61)	5.29(5.57)	18.33(4.28)
T_{11}:Pendimethalin 30% EC @ 1.5 kg a.i. ha^{-1}	13.67(3.69)	17.67(4.20)	21.00(4.57)	28.67(5.35)	19.33(4.39)
T_{12}:Polythene mulch	3.33(1.82)	4.33(2.08)	4.67(2.16)	5.00(2.23)	5.00(2.23)
T_{13}: Unweeded control	35.33(5.93)	40.00(6.32)	42.00(6.44)	55.67(7.46)	34.33(5.85)
S.Em±	1.48(0.17)	1.54(0.19)	7.06(0.22)	1.34(0.12)	1.28(0.14)
CD at 5 %	4.33(0.50)	4.50(0.54)	7.23(0.65)	3.92(0.36)	3.74(0.41)

Table 3: Effect of different weed management methods on weed dry weight (g m^{-2}) in transplanted turmeric

Treatments	30 DAT	45 DAT	60 DAT	90 DAT	180 DAT	Yield per plot (kg ha^{-1})
T_1: Hand weeding (Weed free check)	3.20(1.78)	3.27(1.80)	3.33(1.82)	4.30(2.07)	37.33(6.09)	11.27
T_2:Alachlor 50% EC @ 1 kg a.i. ha^{-1}	15.33(3.86)	221.00(14.86)	371.67(19.27)	668.33(25.85)	1251.67(35.37)	4.81
T_3: Alachlor 50% EC @ 1.5 kg a.i. ha^{-1}	21.33(4.60)	135.67(11.62)	346.67(18.60)	719.00(26.81)	1475.00(38.40)	5.11
T_4: Atrazine 50% WP @ 1kg a.i. ha^{-1}	25.33(5.01)	155.00(12.45)	443.33(21.00)	863.33(29.38)	1680.00(40.99)	4.46
T_5:Atrazine 50% WP @ 1.5 kg a.i. ha^{-1}	16.67(4.05)	226.00(14.96)	520.00(22.80)	1148.33(33.88)	2089.33(45.70)	4.92
T_6: Metribuzin 70% WP @ 0.7 kg a.i. ha^{-1}	11.00(3.29)	79.00(8.87)	176.67(13.28)	313.33(17.70)	891.67(29.65)	4.35
T_7: Metribuzin 70% WP @ 1.05 kg a.i. ha^{-1}	9.33(2.94)	66.33(8.14)	126.67(11.25)	265.00(16.27)	615.67(24.69)	2.55
T_8: Oxyfluorfen 23.5% EC @ 0.2 kg a.i. ha^{-1}	23.33(4.80)	103.00(10.13)	171.67(13.09)	415.67(20.38)	785.67(27.99)	5.68
T_9:Oxyfluorfen 23.5% EC @ 0.3 kg a.i. ha^{-1}	18.33(4.25)	100.00(9.99)	170.67(12.98)	382.00(19.42)	754.00(27.41)	8.04
T_{10}: Pendimethalin 30% EC @ 1 kg a.i. ha^{-1}	18.00(4.18)	100.00(9.99)	157.33(12.51)	601.67(24.53)	950.67(30.77)	6.09
T_{11}:Pendimethalin 30% EC @ 1.5 kg a.i. ha^{-1}	27.67(5.25)	89.00(9.43)	153.33(12.33)	381.00(19.50)	722.67(26.88)	6.16
T_{12}:Polythene mulch	2.67(1.55)	2.93(1.70)	3.13(1.77)	3.43(1.82)	4.43(2.10)	12.61
T_{13}: Unweeded control	62.00(7.87)	535.00(23.11)	772.67(27.79)	1409.33(37.54)	2736.67(52.31)	2.27
S.Em±	2.71(0.33)	13.81(0.49)	19.30(0.58)	21.76(0.51)	61.90(1.04)	0.55
CD at 5 %	7.90(0.95)	40.31(1.43)	56.34(1.69)	63.51(1.50)	180.68(3.05)	1.62

Conclusion

In case of extreme labour shortage and high labour cost, the use of safe herbicides became a must for weed control in transplanted turmeric. Post planting pre-emergent single application of Oxyflourfen 23.5% EC @ 0.3 kg a.i. ha^{-1} as directed spray is better chemical weed management method as Oxyflourfen is less phytotoxic and gives better yield of transplanted turmeric. Further, application of Metribuzin 70% WP has to be avoided as it caused phytotoxicity reducing yield of transplanted turmeric.

References

1. Azad B, Hassandokht MR, Parvizi K. Effect of mulch on some characteristics of potato in Asadabad, Hamedan, Iran. Int. J Agron. Agric. Res. 2015; 6(3):139-147.
2. Bhanumurthy KC, Rani SN, Srinivas A, Rajashekar P, Adarsha S. and Reddy RVSK. Impact of on farm-trail on protray raised seedlings from single node cuttings in turmeric variety JTS-6 in agency area of east Godavari district. J Pharmacognosy and phytochemistry. 2018; 1:889-890.

3. Bhanumurthy VB, Subramanian NS. Adaptation of new parameters, grain yield competition for weed control study. Ind. J Agric. Sci. 1989; 59:800-801.
4. Desai MM. Efficacy of different herbicides on weed dynamics and productivity of turmeric (*Curcuma longa* L.), Ph.D (Agi.) Thesis, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashra (India), 2017.
5. Dvorak PJ, Tomasek P, Kuchtova K, Hamouz J, Hajslova D, Schulzova V. Effect of mulching materials on potato production in different soil climatic conditions. Rom. Agric. Res. 2012; 29:201-209.
6. Gill BS, Randhawa GS. And Saini SS. Integrated weed management studies in turmeric (*Curcuma longa* L.). Ind. J Weed Sci. 2000; 32:114-115.
7. Jaiswal VP, Grewal JS. The efficacy of promising herbicides in controlling weed flora in potato under northwestern plains. Journal of Indian Potato Association. 1991; 21:147150.
8. Krishnamurthy SK. Common weeds of cultivated and grass lands in Mysore. Botanical Survey in Bulletin, 2: Development of Agriculture, Publication Bangalore, Karnataka, India. 1957; 108.
9. Lamont Jr WJ. Plastics: Modifying the microclimate for the production of vegetable crops. Hort. Tech. 2005; 15:477-481.
10. Malhotra SK, Cherian H, Chitra R. Single bud rhizome technique of turmeric for seedling production in portrays. Indian. J arecanut, spices and medicinal plants. 2016; 18(3):34-36.
11. Mannikeri IM. Studies on production technology of turmeric (*Curcuma longa*. L). Ph.D. (Agri.) Thesis, Univ. Agri. Sci. Dharwad, 2006.
12. Mukherjee PK, Rahaman S, Maity SK. and Sinha B. Weed management practices in potato [*Solanum tuberosum* L.]. J Crop & Weed. 2012; 8(1):178-180.
13. Murthy KNK, Fathima PS. and Vidya A. Productivity of direct seeded onion (*Allium cepa* L.) as influence by integrated weed management practices. Int. J Agric. Sci. 2009; 5(2):477-481.
14. Pillai AV. Weed management in ginger (*Zingiber officinale* Rosc.). Ph.D (Agri.) Thesis, Kerala Agri. Univ., Thrissur (India), 2015.
15. Ranpise SA, Patil BT. Effect of herbicides on weed intensity and yield of summer onion cv. N-2-4-1. Pestology. 20012; 5(1):59-60.
16. Thankamani CK, Kandiannan K, Hamza S. and Saji KV. Effect of mulches on weed suppression and yield of ginger (*Zingiber officinale* Roscoe). Hort. Sci. 2016; 207:125-130.