Forage Res., **49**(3) : pp. 298-302 (2023) **http://forageresearch.in**

APPROACHES FOR EFFECTIVE WEED POPULATION MANAGEMENT IN COWPEA CULTIVATION

P. BHASKER[1]*, P. K. GUPTA[2], S. S. BORADE[2], C. TIWARI[3] AND G. SURESH[1]

[1]Department of Botany and Plant Physiology, CCS Haryana Agricultural University, Hisar-125 004 (Haryana), India
[2]National Horticultural Research and Development Foundation, Regional Research Station, Nashik-422003 (Maharashtra), India
[3]National Horticultural Research and Development Foundation, Regional Research Station, Karnal-32001(Haryana), India
**(e-mail : bhaskarhau@gmail.com)*

(Received : 6 September 2023; Accepted : 18 November 2023)

SUMMARY

A significant obstacle to cowpea [*Vigna unguiculata* (L.) Walp.] cultivation is weeds. There was an experiment was arranged in filed under all India coordinated research project - vegetable crops (AICRP-VC) on cowpea variety Kashi Kanchan to minimize the weed infestation during *Kharif* season. The seven different weed management strategies were tested in Randomized Block Design. The combined findings of three years showed that weed free check had the superior weed control efficiency, plant growth, development and pod production while the strategy having a very high investment cost in comparison to other weed management approaches. The black polythene mulch treatment outperformed other weed control methods in terms of weed flora reduction, weed control efficiency, crop growth, development and yield, albeit the treatment is also quite expensive. The PE application of oxyfluorfen @ 150 g ai/ha + one hand weeding at 35 - 45 DAS had the best weed control efficiency, pod yield and benefit cost ratio (1:2.07) followed by PE application of pendimethalin @ 1.0 kg ai/ha (1:2.06). Based on three years period results revealed that using plastic mulch is the most effective technique to control weeds than applying herbicides which had an economically cheap.

Key words: Cowpea, efficacy, herbicide, plastic mulch, weed population

In tropical and subtropical nations cowpea is one of the significant annual legume crops used for seed as well as fodder. Millions of relatively impoverished people depends on the production of cowpea for their nourishment and as a source of fodder for livestock. According to the FAO, 2020 cowpea grown more than 15.0 million ha of land with 591 kg/ha productivity. In India cowpea produced on over 3.9 million ha of land, production 2.21 million ton with 567 kg/ha productivity (Giridhar *et al.,* 2020). Weed infestation especially during rainy season is to blame for the cowpea crop decreased productivity at third and fourth weeks of crop development stages which are more susceptible to weed infestation, if weeds are not controlled at these periods crop growth suffers irreversibly. According to Mekonnen *et al*. 2015 reported that due to heavy weed population can reduce the cowpea yield about 70.8% when compared to weed free fields. Therefore, weed control is a crucial issue to reduce weed infestation during a crucial time for better management, which in turn leads to increased production and productivity. Several methods including manual and chemical methods have been suggested for the effective management of weeds in cowpea with varied degrees of success. Manual weeding is an outdated common weed control practice that marginal farmers use because it is labour intensive and economically unviable, however in manual weeding recorded highest yield as compare to another weed management practices (Kumar *et al.,* 2017; Mekonnen and Dessie 2017). Herbicide application appears to be a different choice when we applied properly, this technique is simple, affordable, quick to work, effective, large area coverage, safe and it also reduces the investment of tillage practises for weed eradication. Herbicides application control all type of weed flora and reduces the production cost, whereas the efficacy should be depends on the right section of herbicide, mode of application and the quantity of recommended dose. PE herbicides, which are typically sprayed in the field before to the emergence of both crops and weeds, which stops the growth of weed roots and shoots, preventing the weed seeds germination. Herbicides used after the emergence of the crop and

weeds known as post emergence herbicides. Rana *et al*. (2019) and Deshkari *et al*. (2019) elucidated that PE application of imazethapyr lowering weed density and biomass in cowpea. Ayisha *et al*. 2023 reported that PE application of imazethapyr + imazamox, 40 g/ha at 5-20 DAS following one hand weeding at 40 DAS performed better and reduces the cost of production. Under modern agriculture plastic mulch use in vegetable crops is one of the important production tactics has implemented in different crops like tomato, potato and chilli (Ashrafuzzaman *et al*., 2008; Helaly *et al*., 2017 and Patel *et al*., 2021). In light of this, the present experiment was designed to determine practical and affordable management options using chemical weed control, plastic mulch and manual weeding techniques to reduce weed infestation for improving growth, yield, productivity and the economic viability of cowpea.

MATERIALS AND METHODS

The field experiment was conducted under all India coordinated research project - vegetable crops (AICRP-VC) during *Kharif* seasons of 2014, 2015 and 2016 at the Regional Research Station of the National Horticultural Research and Development Foundation, Karnal, Haryana (253 meters above sea level and located at 29.74' 86.72' N latitude and 76.99' 86.41' E longitudes). The experimental soil type is sandy to fine sandy loams with an organic carbon content 0.74%, pH 7.97 and EC 0.219 dSm^{-1}. Three replications of 3.0 m × 3.30 m of experimental plots were laid down in Randomized Block Design. The experiment included seven treatments; T_1 - Weedy check; T_2 - Weed free check; T_3 - Mulching with black polythene; T_4 – PE application of pendimethalin @ 1.0 kg ai/ha; T_5 - PE application of pendimethalin @ 1.0 kg ai/ha + one hand weeding at 35 - 45 DAS; T_6 - PE application of oxyfluorfen @ 150 g ai/ha; T_7 - PE application of oxyfluorfen @ 150 g ai/ha + one hand weeding at 35 - 45 DAS. The cowpea variety Kashi Kanchan seeds were sown in the month of July for three crop seasons with a depth of 3 cm at a distance of 30 cm to 35 cm. Before the anticipated harvest stage quadrate approach was used to record narrow and broad leaves weed population in the experimental field randomly in two locations in each plot. Taking note of the amount of weeds in each treatment biomass from the quadrate was chopped close to the surface for the above ground weeds. The following formulas were used to construct various weed management parameters: Weed Control Efficiency:

$$WCE = \frac{DWC - DWT}{DWC} \times 100$$

Weed Index:

$$WI = \frac{YF - YT}{YF} \times 100$$

Agronomic Management Index:

AMI=((YT-YC)/YC-(DWC-DWT)/DWC)/((DWC-DWT)/DWC)

Weed Persistence Index:

$$WPI = \frac{DWT}{DWC} \times \frac{WPC}{WPT} 100$$

where YF is the yield of weed free check, YT is yield of treatment, YC= Yield of control; DWC = weed dry weight in control, DWT = weed dry weight in treatment; WPC = weed population count in control, WPT= weed population count in treatment. The process of analysis of variance carried out by utilizing SPSS software to statistically analysis the various parameter data.

RESULTS AND DISCUSSION

The consequences of various weed control approaches had a significant impact on diverse weed species throughout the course of three subsequent years. The weed free check plot was maintained free from weeds throughout the crop period by manual eradication, in contrast there was no manual weeding and herbicide treatment was done in the weed check plot which had the greatest weed density levels and weed biomass. At critical growth of the crop weed infestation drastically reduce the plant growth and yield by the dominated weed species *Cyperus rotundus, Echinocloa colona, Commelina benghalensis*, etc. due to heavy infestation of these weed species the crop plants unable to compete which hinder the yield. Among the various weed management techniques, mulching with black polythene proved cent percent WCE and effectively controlled all narrow and broad leaf weed populations. This may be plastic mulch kept both type

weeds under control past the crop critical period and maintained soil moisture, which reduced weed growth and helped create suitable conditions for crop growth and development (Table 1). The plastic mulching is common modern practice in commercial vegetable cultivation to reduce weed infestations throughout the cropping season, where weeds, especially at the beginning of the crop season severely reduced crop growth and development (Oliveira *et al*., 2023). In herbicide treatments; combination of PE application of Oxyfluorfen @ 150 g ai/ha + one hand weeding at 35 - 45 DAS outperformed chemical weed control alone in terms of weed population (19.13/m^2), weed biomass (144.72 g), better WCE (59.96%), and lower WI (33.35), WPI (0.77) and highest AMI (5.89) while the chemical weed management practices moderately controlled both narrow and broad leaves weed plants and moderately reduced biomass (Table 2). These results are in line with the findings of Yadav *et al*. (2015) and Bhasker *et al*. (2023).

The height of the cowpea is maximum in each of the weed management approaches used over weedy check as recorded during three subsequent cropping seasons. The results demonstrated that applications of different weed management strategies have significantly influenced on crop growth and development. The highest plant height (61.84 cm) and number of branches (6.90/plant) were achieved in weed free check (Table 3), which was maintained weed free throughout the cropping period as a result crop received adequate nutrients, soil aeration and sunlight which all contribute to the maximum amount of plant growth which leads to the highest green pods length (27.29 cm), pod girth (0.60 cm) and pod yield (121.63 q/ha). The plastic mulching is also effectively minimize the weed infestation throughout the cropping period therefore recorded better pod length (25.83 cm), girth (0.56 cm) and yield (96.33 q/ha). Due to the highest level of weed infestation in weedy check makes the crop unable to compete with the various weed species and reduces growth and production by 20.0% to 74.0%. Among all weed management treatments, the maximum growth and yield with highest WCE and lower WI were recorded weedy check followed by plastic mulching and recorded benefit: cost ratio 1:1.73 and 1:1.72 respectively, whereas, the highest benefit: cost ratio (1:2.07) was obtained in PE application of Oxyfluorfen @ 150 g ai/ha + one hand weeding at 35 - 45 DAS (Table 4). Herbicide use during the early stages of the crop prevents crop weed competition and increases yield by controlling all sorts of weeds. The results are consistent with Usmans (2013) findings

TABLE 1
Cowpea crop weed population, weed biomass and weed control efficiency as influenced by different weed control treatments during *Kharif* season

Treatments*	Weed Population (m^2)**				Weed Dry Weight (g)				Weed Control Efficiency (WCE) (%)			
	1st year	2nd year	3rd year	Pooled	1st year	2nd year	3rd year	Pooled	1st year	2nd year	3rd year	Pooled
T_1	32.23 (5.76)	38.89 (6.31)	40.90 (6.47)	37.34 (6.18)	335.55	381.35	375.32	364.07	0	0	0	0
T_2	0 (1.0)	0 (1.0)	0 (1.0)	0 (1.0)	0	0	0	0	100.0	100.0	100.0	100.0
T_3	0 (1.0)	0 (1.0)	0 (1.0)	0 (1.0)	0	0	0	0	100.0	100.0	100.0	100.0
T_4	21.66 (4.75)	33.07 (5.84)	32.99 (5.83)	29.24 (5.47)	219.38	292.00	291.37	267.59	33.35	23.07	21.44	25.95
T_5	20.47 (4.63)	26.64 (5.25)	29.23 (5.50)	25.45 (5.13)	185.24	217.35	233.41	212.00	44.53	42.80	37.24	41.52
T_6	21.75 (4.76)	33.78 (5.89)	32.49 (5.78)	29.34 (5.48)	175.97	267.63	262.85	235.49	47.28	29.78	29.69	35.58
T_7	17.42 (4.29)	23.17 (4.91)	16.81 (4.21)	19.13 (4.47)	130.01	176.47	127.68	144.72	61.27	53.26	65.37	59.96
S. Em±	0.14	0.14	0.12	0.177	19.94	17.39	19.15	10.89	6.37	3.76	4.74	12.66
C. D. (P=0.05)	0.43	0.44	0.38	0.55	43.45	37.88	41.72	22.08	13.89	8.20	10.33	39.47
CV (%)	6.31	5.63	4.90	7.453	16.34	11.17	12.72	11.32	14.14	9.24	11.49	41.24

*T_1–Weedy check; T_2–Weed free check; T_3–Mulching with black polythene; T_4–PE application of Pendimethalin @ 1.0 kg ai/ha; T_5–PE application of Pendimethalin @ 1.0 kg ai/ha+one hand weeding at 35-45 DAS; T_6–PE application of Oxyfluorfen @ 150 g ai/ha; T_7–PE application of Oxyfluorfen @ 150 g ai/ha+one hand weeding at 35-45 DAS
**Figures in the parentheses shows arcsin transformed values.

TABLE 2
Cowpea crop weed index, weed persistence index and agronomic management index as influenced by different weed control treatments during kharif season

Treatments*	Weed Index (WI)				Weed Persistence Index (WPI)				Agronomic Management Index (AMI)			
	1st year	2nd year	3rd year	Pooled	1st year	2nd year	3rd year	Pooled	1st year	2nd year	3rd year	Pooled
T_1	60.28	85.80	80.19	75.42	1.0	1.0	1.0	1.0	-	-	-	-
T_2	-	-	-	-	-	-	-	-	-	-	-	-
T_3	36.99	10.23	12.15	19.79	-	-	-	-	-	-	-	-
T_4	43.12	71.98	70.51	61.87	0.97	0.90	0.97	0.95	0.70	1.43	0.67	0.94
T_5	38.27	68.10	38.39	48.25	0.87	0.83	0.87	0.86	1.07	2.54	3.23	2.28
T_6	43.13	70.92	68.58	60.88	0.78	0.81	0.88	0.82	0.88	1.75	0.81	1.15
T_7	38.71	25.77	35.59	33.35	0.72	0.78	0.83	0.77	1.54	9.63	6.50	5.89
S. Em±	3.11	3.90	3.35	2.00	0.05	0.01	0.04	7.602	0.26	0.86	0.98	0.87
C. D. (P=0.05)	6.78	8.49	7.31	4.06	0.10	0.03	0.09	23.68	0.56	1.87	2.13	2.72
CV (%)	10.24	10.04	9.42	8.51	9.30	2.69	7.39	81.14	52.40	47.92	74.86	103.4

*T_1–Weedy check; T_2–Weed free check; T_3–Mulching with black polythene; T_4–PE application of Pendimethalin @ 1.0 kg ai/ha; T_5–PE application of Pendimethalin @ 1.0 kg ai/ha +one hand weeding at 35–45 DAS; T_6–PE application of Oxyfluorfen @ 150 g ai/ha; T_7–PE application of Oxyfluorfen @ 150 g ai/ha+one hand weeding at 35-45 DAS.

TABLE 3
Cowpea plant height, number of branches and pod length as influenced by different weed control treatments during kharif season

Treatments*	Plant height (cm)				No. of branches/plant				Green pod length (cm)			
	1st year	2nd year	3rd year	Pooled	1st year	2nd year	3rd year	Pooled	1st year	2nd year	3rd year	Pooled
T_1	34.78	54.87	55.47	48.37	5.80	3.22	5.40	4.81	20.82	21.61	25.12	22.52
T_2	58.15	63.16	64.22	61.84	9.07	5.44	6.20	6.90	26.88	26.71	28.27	27.29
T_3	35.62	56.21	62.88	51.57	7.07	4.33	6.07	5.82	24.21	25.77	27.51	25.83
T_4	44.91	55.23	56.87	52.34	6.33	3.55	5.47	5.12	22.17	23.86	26.31	24.11
T_5	40.96	56.48	57.77	51.74	6.13	3.66	5.67	5.15	22.35	23.43	26.69	24.16
T_6	39.75	53.08	59.33	50.72	6.00	3.77	5.73	5.17	21.81	23.03	26.44	23.76
T_7	38.10	56.89	60.39	51.79	5.80	3.89	5.93	5.21	21.43	23.54	27.14	24.04
S. Em±	2.49	2.58	1.46	1.29	0.43	0.25	0.19	0.18	1.00	0.60	0.49	0.42
C. D. (P=0.05)	5.44	5.63	3.19	2.62	0.94	0.53	0.40	0.36	2.18	1.30	1.07	0.86
CV (%)	7.32	5.59	3.01	4.47	8.02	7.54	3.93	5.90	5.38	3.04	2.26	3.13

*T_1–Weedy check; T_2–Weed free check; T_3–Mulching with black polythene; T_4–PE application of Pendimethalin @ 1.0 kg ai/ha; T_5–PE application of Pendimethalin @ 1.0 kg ai/ha+ one hand weeding at 35-45 DAS; T_6–PE application of Oxyfluorfen @ 150 g ai/ha; T_7–PE application of Oxyfluorfen @ 150 g ai/ha+one hand weeding at 35-45 DAS.

that hand weeding at six weeks after sowing and the PE application of Pendimethalin at 3.5 L a.i./ha significantly boosted yield.

CONCLUSION

Ineffective weed management results significant yield loss was recorded in cowpea during the rainy season. Modern vegetable crop weed management practices often embrace the use of non-chemical weed control techniques like plastic mulching has increased the yield, in addition reduced soil erosion, increased plant water use efficiency and reduced transpiration loss of water, while the hand weeding method efficiently prevents all the weed population with higher yield, but it is economically unbeneficial to the farmer. The chemical weed control method is less expensive than all management techniques, simple to use and effective in reducing all weeds. Herbicide usage, however, depends on the farmer's preference and local availability for the prevalent weed population. Adopting these weed control techniques leads to increased productivity and improved net profit.

TABLE 4
Cowpea green pod girth, green pod yield and benefit cost ratio as influenced by different weed control treatments during kharif season

Treatments*	Green pod girth (cm)				Green pod yield (q/ha)				B:C ratio
	1st year	2nd year	3rd year	Pooled	1st year	2nd year	3rd year	Pooled	
T_1	0.50	0.45	0.56	0.50	54.90	18.94	18.86	30.90	1:1.60
T_2	0.61	0.53	0.66	0.60	139.46	131.22	94.22	121.63	1:1.69
T_3	0.55	0.51	0.64	0.56	87.90	118.20	82.88	96.33	1:1.72
T_4	0.55	0.48	0.56	0.53	79.09	36.70	27.72	47.84	1:1.87
T_5	0.52	0.49	0.61	0.54	85.88	41.50	57.77	61.72	1:2.06
T_6	0.52	0.49	0.58	0.53	79.22	37.98	29.38	48.86	1:1.91
T_7	0.51	0.50	0.63	0.55	85.25	97.09	60.39	80.91	1:2.07
S. Em±	0.02	0.01	0.02	0.01	5.13	6.34	3.94	3.02	-
C. D. (P=0.05)	0.03	0.03	0.05	0.02	11.18	13.82	8.58	6.12	-
CV (%)	3.48	3.04	4.34	3.23	7.19	11.29	9.09	7.87	-

*T_1–Weedy check; T_2–Weed free check; T_3–Mulching with black polythene; T_4–PE application of Pendimethalin @ 1.0 kg ai/ha; T_5–PE application of Pendimethalin @ 1.0 kg ai/ha + one hand weeding at 35-45 DAS; T_6–PE application of Oxyfluorfen @ 150 g ai/ha; T_7–PE application of Oxyfluorfen @ 150 g ai/ha+one hand weeding at 35-45 DAS.

REFERENCES

Ashrafuzzaman, M., A.M. Halim, S.M. Ismailm, M. Shahidullah, and A. Hossain 2011 : Effect of plastic mulch on growth and yield of chilli (*Capsicum annuum* L.). *Braz. Arch. Biol. Technol*., On-line version ISSN 1678-4324.

Ayisha, P.J., S. Anitha, P. Prameela, K. Sreelakshmi, and K. Rajalekshmi, 2023 : Crop establishment methods and weed management on productivity of cowpea. *Indian J. Weed Sci.*, **55**(1): 107-110.

Bhasker, P., P.K. Gupta, S.S. Borade, C. Tiwari, and B.K. Dubey, 2023 : Weed population and cowpea yield as influenced by various weed management approaches under Haryana conditions. *Forage Res.,* **49**(1): 130-136.

Deshkari, S.M., P.C. Pagar, S.T. Dangore, V.S. Khawale and H.S. Mendhe, 2019 : Effect of imazethapyr + imazamox on weed control in soybean. *J. Soil. Crop.,* **29**(2): 280-284.

Giridhar, K., P.S. Raju, G. Pushpalatha, and C. Patra, 2020 : Effects of plant density on yield parameters of cowpea (*Vigna unguiculata* L.). *Int. J. Chem. Stud.,* **8**: 344-347. *DOI: 10.22271/chemi.2020. v8.i4f.10090.*

Helaly, A.A., Y. Goda, A.A.S. El-Rehim, A.A. Mohamed and O.A.H. El-Zeiny, 2017 : Effect of polyethylene mulching type on the growth, yield and fruits quality of *Physalis Pubescens*. *Adv Plants Agric Res*., **6**(5): 00229. *DOI: 10.15406/apar.2017.06. 00229.*

Kumar, N., K.K. Hazra, and N. Nadarajan, 2017 : Efficacy of pre and post-emergence herbicides in rainy sea son green gram (*Vigna radiata*). *Indian J. Agric. Sci.,* **87** (9): 1219-1224.

Mekonnen, G., J.J. Sharma, L. Negatu and T. Tana, 2015 : Effect of integrated weed management practices on weeds infestation, yield components and yield of cowpea [*Vigna unguiculata* (L.) Walp.] in eastern Wollo, northern Ethiopia. *J. Exp. Agric. Int*., **7**(5): 326-346.

Mekonnen, G. and M. Dessie, 2017 : Nodulation and yield response of cowpea (*Vigna unguiculata*) to integrated use of planting pattern and herbicide mixtures in Wolla, Northern Ethiopia. *Agric. Res. Tech.,* **7**(2): 555710. *DOI: 10.19080/ ARTOAJ.009. OAJ.20 17.07.555710.*

Oliveira, D., T. Raissa, Serafim, A. Dubou Breland, Brenton, Miller, Alyssa, Beneton, Karina, Singh, Varsha, Segbefia, Worlanyo, Argenta, Josiane, C., Broderick, Shaun R., Tseng and Ming, T., 2023 : An integrated weed management approach in tomato using soil steaming, mulching, and winter cover crops, *Front. Agron*., **5**: 1075726. *DOI: 10.3389/fagro.2023.1075726.*

Patel, H.F., S.K. Attar, A.I. Makwana and J.K. Bana, 2021 : Effect of mulching and herbicides on weeds, yield and economics of tomato grown under drip irrigation system. *Indian J. Weed Sci.*, **53(**2): 195-197.

Rana, S.S., G. Singh, M.C. Rana, N. Sharma, S. Kumar, G. Singh and Badiyala, 2019 : Impact of imazethapyr and its ready-mix combination with imazamox to control weeds in black gram. *Indian J. Weed Sci.*, **51**(2): 151-157.

Usman, I., 2013 : Effect of pre emergence herbicides on weed control and performance of cowpea in Samaru. *J. Agricultural Sci*., **8**(2): 76-81.

Yadav, T., K. Chopra Nisha and N.K. Chopra, 2015 : Efficacy of pre- and post-emergence herbicides with and without weeding in forage cowpea (*Vigna unguiculata*). *Indian J. Agron.*, **60**: 622-625.