



Influence of Different Herbicide Based Weed Management Practices on Growth and Yield of Flue Cured Tobacco in Northern Light Soils of Andhra Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Flue cured tobacco requires clean and weed free environment and thereby reduce the competition for nutrients and moisture for achieving quick early season growth. Deploying effective weed management practices play a key role in achieving better yields and quality. Field experiments were conducted at Peddapuram village of West Godavari district (Andhra Pradesh) during (Rabi) seasons of 2018-19 and 2019-20, to study the effect of different herbicide based weed

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management practices on growth and yield of flue cured Tobacco crop. The experiment was performed as Randomized Block Design with 11 weed management practices replicated thrice. The results recorded on growth parameters, in both the years revealed that six inter cultivations with two manual removal of weeds significantly impacted plant height (113.5 cm and 114.4 cm) and leaf area index (2.63 and 2.83) at 90 DAT over Imazethapyr applied at 0.05 kg a.i ha⁻¹. Number of leaves plant⁻¹ were higher with six inter cultivation and two manual removal of weeds (21.5 and 20.6) over Imazethapyr 0.05 kg a.i ha⁻¹. Inter cultivations and manual weeding resulted in significantly enhancing yield attributes such as leaf thickness (0.143 mm and 0.143 mm for cutters and 0.183 mm and 0.173 for leaf) and lower leaf count (Number of leaves kg⁻¹) (137 and 129) over weedy check. Application of Sulfentrazone 0.03 kg a.i ha⁻¹ was comparable with inter cultivation and manual weeding. Sulfentrazone 0.3 kg a.i ha⁻¹ contributed for significantly higher yield (2302 kg ha⁻¹ and 2424 kg ha⁻¹) over weedy check and comparable with six inter cultivations and two manual weeding operations. The application of pre emergence herbicides like Pendimethalin, Alachlor and Oxyflufen resulted achieving higher yield levels over the application of post emergence herbicides such as Quiazalofop-p-ethyl, Fenoxaprop ethyl, Carfentrazone ethyl and Imazethapyr during both years of experimentation.

Keywords: Growth parameters; leaf area index; leaf thickness; leaf count, weed control; yield; Tobacco.

1. INTRODUCTION

Tobacco is one of India's most important commercial crops, growing in a variety of soils and climates. After China, India is second in terms of production with 800 million kg (comprising both cigarette and non-cigarette varieties) [1]. Tobacco occupies 0.24% of arable area of India and majorly cultivated in semi-arid region under rain fed condition. 60% of cigarette tobacco, predominantly flue cured (FC) tobacco produced in India is being exported to different countries and reap foreign exchange earnings of around ₹.3000 crores annually [1]. In addition to other production practices, weed management plays a critical role in enhancing yield and quality of tobacco. Weed flora compete with tobacco for inputs like soil moisture and nutrients and act as alternate host for pests and diseases impacting yield and quality. Manual weeding became expensive in FC tobacco farming due to scarcity of labour and consequential rise in wages. The lack of labour during vital stages of crop growth is a significant barrier, necessitating the use of herbicides. Because FC tobacco is mostly grown for export, it is critical to identify herbicides that are suitable for tobacco, both for pre-transplant, pre-emergence, and post-emergence in nature, without leaving residues in the lamina or in the soil. Since FC tobacco is wide spaced crop, it provides adequate opportunity for application of herbicides. With this background, a field study was under taken to study the impact of different pre transplant, pre emergence and post emergence herbicides in FC tobacco.

2. MATERIALS AND METHODS

Field experiments were conducted at Peddapuram village of West Godavari (District), Andhra Pradesh, India during Rabi 2018-19 & 2019-20 in Randomized Block Design with eleven treatments replicated thrice. The texture of soil was sandy clay with pH of 6.41(Slightly acidic) and low in organic carbon (0.42%). The treatments were comprised of 11 weed control methods viz, W₁ – PRTR (pre transplant) [2,3] Sulfentrazone 39.6% SC @ 0.3 kg a.i. ha⁻¹, W₂ - PE (Pre emergence) Pendimethalin 30% EC @ 0.75 kg a.i. ha⁻¹, W₃- PE Oxyfluorfen 23.5 % EC @ 0.25 kg a.i. ha⁻¹, W₄- PE Alachlor 50% EC @ 0.75 kg a.i. ha⁻¹, W₅ – POE(Post emergence) Quiazalofop-p- ethyl 5% EC @ 0.05 kg a.i. ha⁻¹ at 25 DAT, W₆ – POE Imazethapyr 10% SL @ 0.05 kg a.i. ha⁻¹ at 25 DAT, W₇ - POE Fenoxaprop ethyl 9% EC @ 0.056 kg a.i. ha⁻¹ at 25 DAT, W₈ – POE Propaquizafop Ethyl 10% EC @ 0.05 kg a.i. ha⁻¹ at 25 DAT, W₉ – POE Carfentrazone ethyl [4] 40 % DF (Protected spray) @ 0.02 kg a.i. ha⁻¹ at 25 DAT, W₁₀ – Farmers Practice (6 inter cultivations and two manual weeding) and W₁₁ – Control (Weedy Check).

Flue cured (FC) Tobacco Cultivar CH 3 was transplanted at a spacing of 105 cm X 60 cm between rows and plants, respectively, in plots of size 9.0 m X 6.3 m. Herbicides were sprayed with Knapsack sprayer fitted with flat fan nozzle. Sulfentrazone was sprayed two days before plantation, Pendimethalin, Oxyfluorfen and Alachlor were sprayed as pre emergence within two days after plantation and Quiazalofop,

Imazethapyr, Fenoxaprop, Propaquizafop and Carfentrazone were sprayed as post emergence at 25 DAT. The production practices recommended for FC tobacco by Indian Council of Agricultural Research - Central Tobacco Research Institute were followed for managing the crop.

Five plants were selected randomly and tagged for recording observations in each plot. Growth parameters viz., plant height (cm) and leaf area index were recorded at 90 DAT from penultimate rows of each plot. The leaf area was calculated by multiplied by a constant 0.653 [5] to get actual leaf area and then leaf area index (LAI) was calculated by dividing the leaf area plant⁻¹ by ground area occupied by each plant (6300 cm²). The harvested leaves were cured and graded based on plant position, ripeness and colour. The graded cured leaf of each net plot (7.8 m X 4.2 m) was recorded and expressed as cured leaf yield. The yield from each plot was recorded separately as kg plot⁻¹ and then expressed as kg ha⁻¹.

The data recorded on identified parameters were analysed statistically by the significance of "F" and "t" test was tested at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Plant height and Leaf Area Index

The data indicated that weed management practice through Inter cultivations and hand weeding recorded higher plant height (113.5 cm and 114.4 cm) which was statistically comparable with pre emergence, post emergence herbicides and weedy check except POE Imazethapyr 0.05 kg a.i. ha⁻¹ at 90 DAT during both the years of experimentation. The application of Imazethapyr 0.05 kg a.i. ha⁻¹ treated plots resulted in lower plant height, since the treatment induced phytotoxicity and retarded plant growth. Among herbicide treatments, pre emergence application of Pendimethalin 0.75 kg a.i. ha⁻¹ (113.1cm), Quizalofop-p-ethyl 0.05 kg a.i. ha⁻¹ (114cm) in both the years resulted in statistically comparable plant height with other herbicide treatments and significantly higher than Imazethapyr 0.05 kg a.i. ha⁻¹. The results recorded in this experiment were similar to the observations of the study in Anand [6]. Higher leaf area index (2.75 and 2.94) was recorded with POE of Fenoxaprop 0.056 kg a.i. ha⁻¹ and Carfentrazone 0.02 kg a.i. ha⁻¹ during 2018-19

and 2019-20, and these results were at par with other herbicide treatments and significantly superior over Imazethapyr 0.05 kg a.i. ha⁻¹.

3.2 Number of Leaves Plant⁻¹ and Leaf Thickness

The mean data of number of leaves plant⁻¹ were not significantly different among the different herbicide treatment. Imazethapyr 0.05 kg a.i. ha⁻¹ resulted in significantly lower number of leaves plant⁻¹ (16.5 and 16.7) due to phyto toxic effect. However, higher number of leaves plant⁻¹ (21.5 and 20.6) was recorded with Inter cultivations (6) and hand weeding (2) and followed by Quazalofop-p-ethyl (21.2 and 20.3) treatments in both the crop growing seasons. Because the number of leaves per plant is determined by the genetic potential of each crop, herbicidal treatments had no effect on the number of leaves. The results are in conformity with the outcome of experimental trials in Pakistan [7]. Results from the study indicated production of thicker leaves in Cutter & Leaf positions (0.143, 183 and 0.143, 0.173) with inter cultivations and hand weeding followed by pre transplant application of Sulfentrazone 0.03 kg a.i. ha⁻¹ and production of thinner leaves with weedy check (0.097, 0.117 and 0.118, 0120) during 2018-19 and 2019-20 respectively. The response of higher leaf thickness can be attributed to better weed management with the treatments that enabled weed free environment leading to higher availability of nutrients and soil moisture.

3.3 Leaf Count and Yield

Lower leaf count (Number of leaves kg⁻¹) (133 and 130) was recorded with Sulfentrazone 0.3 kg a.i ha⁻¹ and higher leaf count (196 and 194) with weedy check. Application of Sulfentrazone resulted in higher yield (2302, 2424 kg ha⁻¹) which is at par with yield (2429, 2545 kg ha⁻¹) obtained in inter cultivations and hand weeding and these set of treatments are significantly superior over weedy check (1386, 1453 kg ha⁻¹) in both the years. All herbicide treatments are comparable and significantly superior over Imazethapyr 0.05 kg a.i ha⁻¹ and weedy check. Though Imazethapyr application resulted in achieving comparable weed control with other herbicides, it resulted in stunted plant growth and developing phyto toxic symptoms leading to lower yield. Sulfentrazone provided weed free environment throughout the crop cycle influencing yield attributes like leaf count and leaf thickness, leading higher yield and proved to be

Table 1. Effect of weed management practices on plant height and leaf area index at 90 DAP during Rabi 2018-19 and 2019-20

Treatments	Plant height (cm)		Leaf Area Index	
	2018-19	2019-20	2018-19	2019-20
W ₁ : PRTR (pre transplant) Sulfentrazone 39.6% SC @ 0.3 kg a.i. ha ⁻¹	109.5	105.3	2.44	2.81
W ₂ : PE Pendimethalin 30% EC @ 0.75 kg a.i. ha ⁻¹	113.1	106.4	2.38	2.65
W ₃ : PE Oxyfuorfen 23.5 % EC @ 0.25 kg a.i. ha ⁻¹	112.8	107.8	2.28	2.73
W ₄ : PE Alachlor 50% EC @ 0.75 kg a.i. ha ⁻¹	112.3	111.9	2.47	2.70
W ₅ : POE Quizalofop-p- ethyl 5% EC @ 0.05 kg a.i. ha ⁻¹ at 25 DAT	112.9	114.0	2.75	2.85
W ₆ : POE Imazethapyr 10% SL @ 0.05 kg a.i. ha ⁻¹ at 25 DAT	82.2	89.3	1.64	1.83
W ₇ : POE Fenoxaprop ethyl 9% EC @ 0.056 kg a.i. ha ⁻¹ at 25 DAT	108.1	107.0	2.75	2.81
W ₈ : POE Propaquizafop Ethyl 10% EC @ 0.05 kg a.i. ha ⁻¹ at 25 DAT	108.7	106.6	2.12	2.59
W ₉ : POE Carfentrazone ethyl 40 % DF @ 0.02 kg a.i. ha ⁻¹ at 25 DAT	105.5	101.1	2.52	2.94
W ₁₀ : Farmers Practice (4-6 intercultivations & Hand Weeding)	113.5	114.4	2.63	2.83
W ₁₁ : Control (Weedy Check)	99.6	98.8	2.15	2.33
SEd	6.14	5.46	0.25	0.27
CD (P=0.05)	12.81	11.39	0.52	0.56

Table 2. Effect of weed management practices on number of leaves plant⁻¹ at 90 DAP and Leaf thickness after curing during Rabi 2018-19 and 2019-20

Treatments	No. of leaves plant ⁻¹		Leaf Thickness (mm)			
	2018-19	2019-20	2018-19		2019-20	
			Cutters	Leaf	Cutters	Leaf
W ₁ : PRTR (pre transplant) Sulfentrazone 39.6% SC @ 0.3 kg a.i. ha ⁻¹	20.5	19.8	0.135	0.183	0.142	0.176
W ₂ : PE Pendimethalin 30% EC @ 0.75 kg a.i. ha ⁻¹	19.5	18.9	0.126	0.164	0.134	0.164
W ₃ : PE Oxyfuorfen 23.5 % EC @ 0.25 kg a.i. ha ⁻¹	20.4	19.8	0.126	0.162	0.135	0.163
W ₄ : PE Alachlor 50% EC @ 0.75 kg a.i. ha ⁻¹	20.4	19.8	0.112	0.164	0.130	0.162
W ₅ : POE Quizalofop-p- ethyl 5% EC @ 0.05 kg a.i. ha ⁻¹ at 25 DAT	21.2	20.3	0.120	0.154	0.148	0.144
W ₆ : POE Imazethapyr 10% SL @ 0.05 kg a.i. ha ⁻¹ at 25 DAT	16.5	16.7	0.123	0.158	0.131	0.148
W ₇ : POE Fenoxaprop ethyl 9% EC @ 0.056 kg a.i. ha ⁻¹ at 25 DAT	20.3	19.9	0.114	0.158	0.124	0.147
W ₈ : POE Propaquizafop Ethyl 10% EC @ 0.05 kg a.i. ha ⁻¹ at 25 DAT	20.7	18.4	0.112	0.154	0.127	0.144
W ₉ : POE Carfentrazone ethyl 40 % DF @ 0.02 kg a.i. ha ⁻¹ at 25 DAT	20.5	19.6	0.100	0.132	0.125	0.130
W ₁₀ : Farmers Practice (4-6 inter cultivations & Hand Weeding)	21.5	20.6	0.143	0.183	0.143	0.173
W ₁₁ : Control (Weedy Check)	19.6	18.0	0.097	0.117	0.118	0.120
SEd	1.13	0.97	0.005	0.007	0.005	0.009
CD (P=0.05)	2.35	2.02	0.01	0.015	0.01	0.02

Table 3. Effect of weed management practices on leaf count and cured leaf yield of Tobacco during Rabi 2018-19 and 2019-20

Treatments	Leaf Count (No. of leaves kg ⁻¹)		Cured leaf yield(kg ha ⁻¹)	
	2018-19	2019-20	2018-19	2019-20
W ₁ : PRTR (pre transplant) Sulfentrazone 39.6% SC @ 0.3 kg a.i. ha ⁻¹	133	130	2302	2424
W ₂ : PE Pendimethalin 30% EC @ 0.75 kg a.i. ha ⁻¹	134	131	2234	2304
W ₃ : PE Oxyfluorfen 23.5 % EC @ 0.25 kg a.i. ha ⁻¹	138	134	2184	2341
W ₄ : PE Alachlor 50% EC @ 0.75 kg a.i. ha ⁻¹	145	142	2045	2272
W ₅ : POE Quizalofop-p- ethyl 5% EC @ 0.05 kg a.i. ha ⁻¹ at 25 DAT	159	156	1918	2112
W ₆ : POE Imazethapyr 10% SL @ 0.05 kg a.i. ha ⁻¹ at 25 DAT	170	160	1419	1626
W ₇ : POE Fenoxaprop ethyl 9% EC @ 0.056 kg a.i. ha ⁻¹ at 25 DAT	154	150	2002	2092
W ₈ : POE Propaquizafop Ethyl 10% EC @ 0.05 kg a.i. ha ⁻¹ at 25 DAT	157	152	1879	2046
W ₉ : POE Carfentrazone ethyl 40 % DF @ 0.02 kg a.i. ha ⁻¹ at 25 DAT	183	182	1620	1741
W ₁₀ : Farmers Practice (6 inter cultivations & Hand Weeding)	137	129	2429	2545
W ₁₁ : Control (Weedy Check)	196	194	1386	1453
SEd	7.14	6.94	170.2	143.9
CD (P=0.05)	14.89	14.54	355.0	300.0

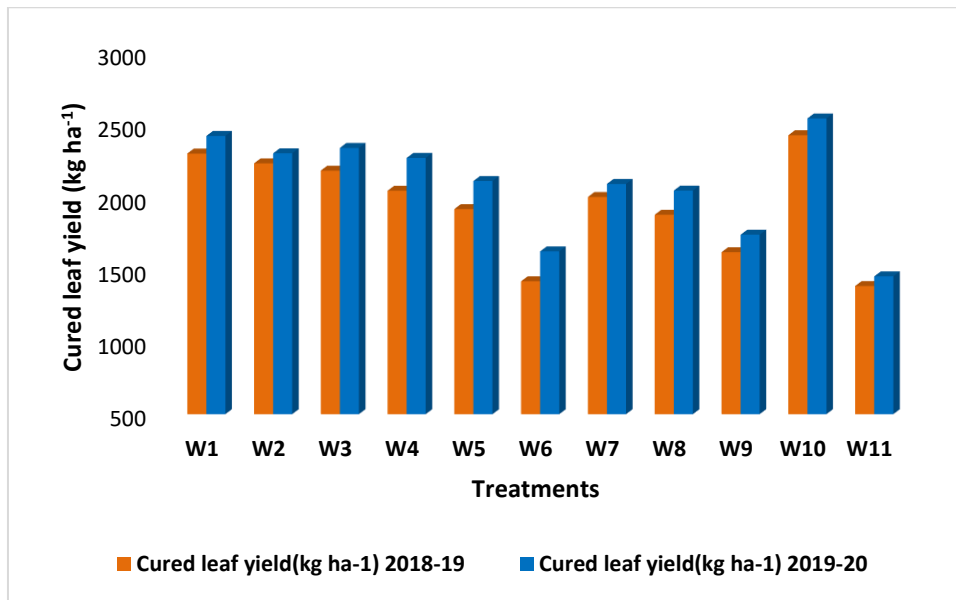


Fig. 1. Effect of weed management practices on cured leaf yield of Tobacco during Rabi 2018-19 and 2019-20

beneficial over post emergence herbicide application. The experimental outcome are in conformity with results of Yousafzai [7]. They stated that use of herbicides like pendimethalin resulted in improvement in yield. Willian [8-10] concluded that herbicide systems [11-12] that include sulfentrazone enhanced the yield in Dark fire cured tobacco [13].

4. CONCLUSION

Weed management practices had a significant impact on FC Tobacco's growth, yield attributes, and yield. The current investigation resulted in identifying an appropriate herbicide like Sulfentrazone, applied at 0.3 kg a.i. ha⁻¹ as pre transplant application provides effective weed control there by influencing favorable yield attributes leading to higher yield in FC tobacco.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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