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Weed management integrating plant extract in *rabi* maize

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Abstract

This study explores the use of *Lantana camara* extract and rice straw mulch for integrated weed management in *rabi* maize, aiming to provide an environmentally sustainable alternative to chemical herbicides. Conducted at Assam Agricultural University during the *rabi* season of 2021-22, the experiment used a randomized block design with 16 treatments. Results indicate that applying 15% *L. camara* extract at 15 days after sowing (DAS), followed by mechanical weeding at 30 DAS, achieved the highest weed control efficiency (WCE) and weed control index (WCI). This treatment significantly reduced weed density and dry matter, contributing to improved dry matter accumulation in plants and enhanced cob yield. Findings highlight that *L. camara* extract, particularly when combined with mechanical weeding, can effectively manage weed growth, underscoring its potential in sustainable maize cultivation.

Keywords: *Lantana camara*, weed control efficiency, weed control index, weed index, plant extract

Introduction

Maize (*Zea mays* L.) is the third most important cereal crop in India and serves as basic raw material to several industrial products such as starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceuticals, cosmetics, textile, gum, paper, package and bio-fuel. The “Miracle Crop” has a potential to capture market because of its wide use as food, fodder and an industrially important crop. Although the “Queen of the Cereals” has the highest yield potential among the cereal crops, but it has so far could not be realized up to its limit due to several constraints (Das *et al.*, 2016) [2] like weeds, pest and diseases that affect the crop yield. The growth of maize plant is slow in the first 3-4 weeks and thus weeds establish and take competitive advantage over the crop during this period. The maximum competition between weeds and maize for resources occurs during the period of 2 to 6 weeks after sowing, suggesting the importance of maintaining weed free environment during the early stage of crop growth (Naik and Velayutham, 2018) [4]. Weed infestation reduces *rabi* maize yield in the range of 30 to 65% (Rani *et al.*, 2019 and Soren *et al.*, 2018) [6, 8]. In order to reduce the weed losses, several approaches are available such as mechanical, cultural and chemical methods. Although chemical method is quicker, more effective, time and labour saving method of weed control, with the increasing demand of organic farming, there is an urgent need of an alternative to herbicide. In the era of sustainable agriculture, the use of environment friendly methods for weed control is realizing attention in agriculturist. Thus, several non-chemical means such as crop mulch and plant extracts showing allelopathic effect could be an ideal alternative to herbicide. With this idea the experiment has been conducted using extract of *Lantana camara* and rice straw. It could be a good option in weed management because of presence of various allelochemicals compounds in roots, stems, flowers, fruits and leaves of *L. camara* and straw of rice (Noguchi and Kurniadie, 2021) [5].

The experiment was conducted at Instructional-cum-Research farm, Assam Agricultural University, Jorhat during *rabi*, 2021-22. The site was not cultivated to grow any crop in the preceding season. The soil of the research site was sandy loam with pH, soil organic carbon available nitrogen, phosphorous and potassium 5.12, 0.52%, 158.20 kg/ha, 24.78 kg/ha and 168.30 kg/ha, respectively. The maize variety PAC 751 was sown on 11 November, 2021 @

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22.50 kg/ha with a spacing of 60cm x 20cm. The experiment was laid out in a randomized block design with three replications where 16 weed management treatments viz., W₁- Weedy check, W₂- Weed free check, W₃- Rice straw mulch @ 2 t/ha, W₄- *L. camara* extract (5%) 2 sprays at 15 and 30 DAS, W₅- *L. camara* extract (10%) 2 sprays at 15 and 30 DAS, W₆- *L. camara* extract (15%) 2 sprays at 15 and 30 DAS, W₇- Mixture of *L. camara* + rice straw extract (5%) 2 sprays at 15 and 30 DAS, W₈- Mixture of *L. camara* + rice straw extract (10%) 2 sprays at 15 and 30 DAS, W₉- Mixture of *L. camara* + rice straw extract (15%) 2 sprays at 15 and 30 DAS, W₁₀- *L. camara* extract (5%) spray at 15 DAS followed by one mechanical weeding at 30 DAS, W₁₁- *L. camara* extract (10%) spray at 15 DAS followed by one mechanical weeding at 30 DAS, W₁₂- *L. camara* extract (15%) spray at 15 DAS followed by one mechanical weeding at 30 DAS, W₁₃- Metribuzin 0.50 kg/ha pre-emergence followed by *L. camara* extract (5%) spray at 30 DAS, W₁₄- Metribuzin 0.50 kg/ha pre-emergence followed by *L. camara* extract (10%) spray at 30 DAS, W₁₅- Metribuzin 0.50 kg/ha pre-emergence followed by *L. camara* extract (15%) spray at 30 DAS and W₁₆- Metribuzin 0.50 kg/ha pre-emergence were allotted randomly. Recommended dose of urea, SSP and MOP

(175-250-65 kg/ha) were applied to the crop. *L. camara* 5, 10 and 15% extracts were prepared based on the ratio of 1:20, 1:10 and 1: 6.7 (W/V) of dried *L. camara* (leaves, stem and flowers): water. Collected, chopped, dried and treatment wise weighed plant parts of the weed was soaked in predetermined amount of water, and kept for 48 hours after sufficient stirring and then filtered in the next morning using a muslin cloth. The extract obtained was sprayed within 24 hours as per the treatments (Carrubba *et al.*, 2020) [1]. Similar method was followed by taking equal amount of dried *L. camara* and rice straw cuttings to prepare mixture extracts of 5, 10 and 15%.

Weeds species were collected treatment wise by placing 0.25 m² quadrat randomly at two places per plot at 30, 60 and 90 DAS of maize and converted to weed density/m². After sun drying, samples were kept in oven category wise at 65±5°C inside perforated brown paper bags till a constant weight attained and the average was converted to g/m² to obtain weed dry matter. The values such obtained were normalized using square root transformation ($\sqrt{x+0.5}$) (Gomez and Gomez, 1984) [3]. Weed control efficiency (WCE), weed control index (WCI) and weed index (WI) was calculated by the following formulae. Cob yield of the crop was used to calculate the weed index.

$$WCE (\%) = \frac{\text{Weed density (no./m}^2\text{) of weedy check} - \text{Weed density (no./m}^2\text{) of treated plot}}{\text{Weed density (no./m}^2\text{) of weedy check}} \times 100$$

$$WCI (\%) = \frac{\text{Weed dry matter (g/m}^2\text{) in weedy check} - \text{Weed dry matter (g/m}^2\text{) in treated plot}}{\text{Weed dry matter (g/m}^2\text{) in weedy check}} \times 100$$

$$WI (\%) = \frac{\text{Yield of weed free check (q/ha)} - \text{Yield of treated plot (q/ha)}}{\text{Yield of weed free check (q/ha)}} \times 100$$

Major twelve weed species observed in the experimental area were *Panicum repens* L., *Cynodon dactylon* (L.) Pers., *Commelina diffusa* L., *Cyperus rotundus* L., *Polygonum plebeium* R. Br., *Oxalis corniculata* L., *Oxalis debilis* Kunth, *Alternanthera sessilis* (L.) R.Br. ex DC, *Crassocephalum crepidioides* (Benth.) S. Moore, *Amaranthus viridis* Hook. f., *Ageratum houstonianum* Mill. and *Ageratum conyzoides* L.

All the weed management treatments showed higher WCE, WCI and lower WI over weedy check. The reduction in population of weeds due to inhibition in germination and subsequent growth of weed's seedling resulted into higher per cent of monocot, dicot and total WCE (52.44, 83.72 and 62.79, respectively) and WCI (70.55, 88.90 and 72.79, respectively) at 30 DAS under *Lantana camara* extract (15%) spray at 15 DAS followed by one mechanical weeding at 30 DAS (W₁₂) (Fig: 1 and 2). Control of weeds by mechanical weeding at 30 DAS under the same treatment subsequently resulted lower weed dry matter and weed density at 60 and 90 DAS resulting in higher per cent of monocot, dicot and total WCE (81.43, 100.00, 91.08 and 72.43, 100.00, 83.12, respectively) and WCI (87.17, 100.00, 89.87 and 66.84, 100.00, 75.63, respectively) over weedy check and was closely followed by *Lantana camara* extract (10%) spray at 15

DAS followed by one mechanical weeding at 30 DAS (W₁₁). However, in case of dicot weeds W₁₄ and W₁₅ also recorded 100 per cent WCE and WCI.

Reduction in weed growth under different weed management treatments attributed to significantly higher dry matter accumulation at 30, 60 and 90 DAS and cob yield of *rabi* maize over weedy check (Table. 1). However, per cent increase in dry matter accumulation was higher under W₁₂ (30.00, 76.30 and 171.77, respectively) over weedy check and was at par with W₁₁ and W₁₆. Similarly, cob yield was 42.38 per cent higher under W₁₂ over weedy check and was statistically at par with weed free check (W₂). Improvement in dry matter accumulation and cob yield were due to reduced crop-weed competition during critical crop growth period providing favorable environment that enhanced resource use, expanding the photosynthetic area and increasing photosynthate movement to the sink. These findings are in line with Sadak (2019) [7] and Timsina *et al.* (2019) [9]. Data clearly shows that higher WCE and WCI with *L. camara* extract (15%) spray at 15 DAS followed by one mechanical weeding at 30 DAS (W₁₂) improved cob yield resulting a lower WI (10.12) compared to other treatments (Fig. 3).

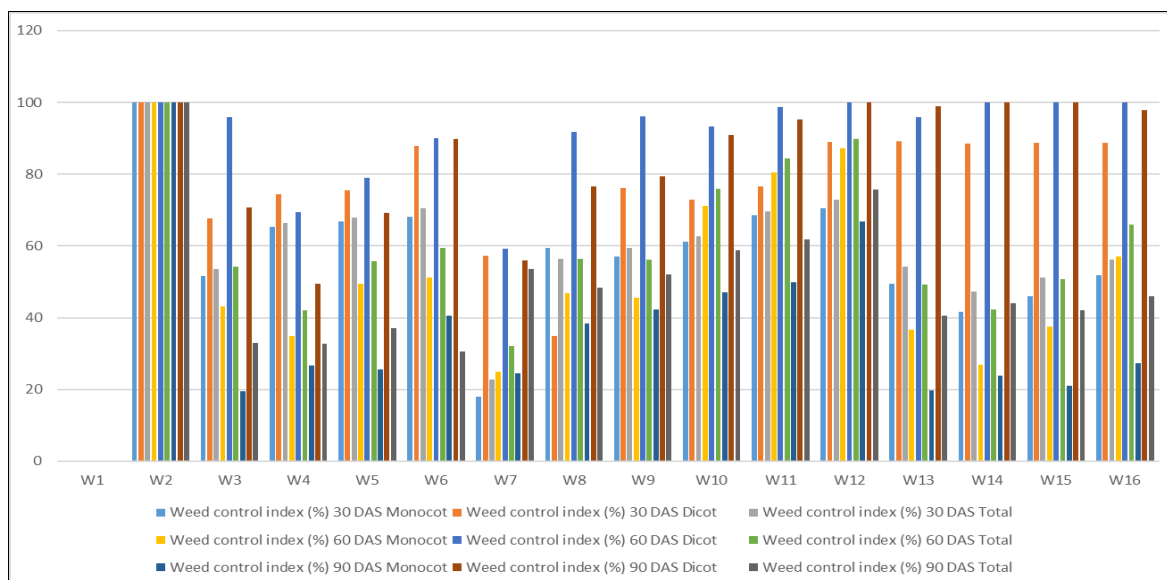


Fig 1: Effect of weed management practices on WCI at 30, 60 and 90 DAS of *rabi* maize

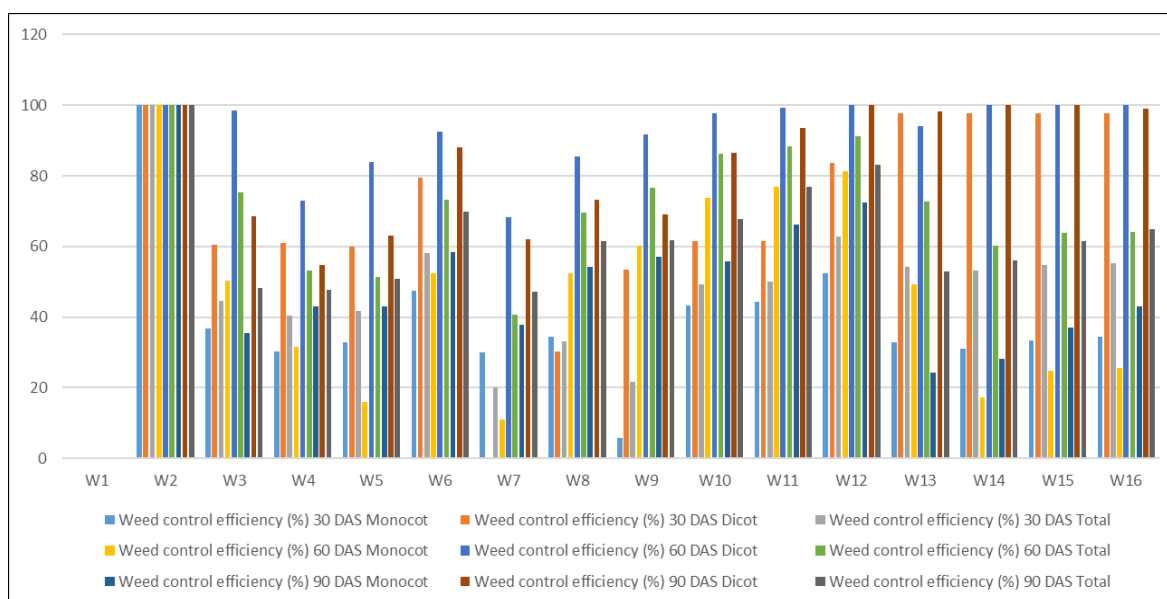


Fig 2: Effect of weed management practices on WCE at 30, 60 and 90 DAS of *rabi* maize

Table 1: Effect of weed management practices on dry matter accumulation at 30, 60 and 90 DAS and cob yield of *rabi* maize

Treatments	Dry matter accumulation (g/plant)			Cob yield (q/ha)
	30 DAS	60 DAS	90 DAS	
W ₁	1.00	5.57	19.02	36.60
W ₂	1.30	12.45	54.60	59.01
W ₃	1.03	7.54	39.49	45.51
W ₄	1.00	5.65	28.49	41.84
W ₅	1.10	5.77	35.90	44.56
W ₆	1.08	5.99	33.83	45.66
W ₇	1.00	6.74	37.11	40.91
W ₈	1.07	6.54	39.28	43.20
W ₉	1.10	5.97	27.46	43.61
W ₁₀	1.27	8.32	45.68	48.40
W ₁₁	1.30	8.82	46.12	49.62
W ₁₂	1.30	9.82	51.69	52.11
W ₁₃	1.12	7.57	43.33	46.46
W ₁₄	1.23	7.27	42.00	47.69
W ₁₅	1.12	8.07	41.37	48.10
W ₁₆	1.27	8.86	49.12	48.82
S.Em ±	0.08	0.56	3.00	2.59
CD (P= 0.05)	0.23	1.61	8.66	7.48

Note: Refer to the methodology for treatment details, DAS: Days after sowing

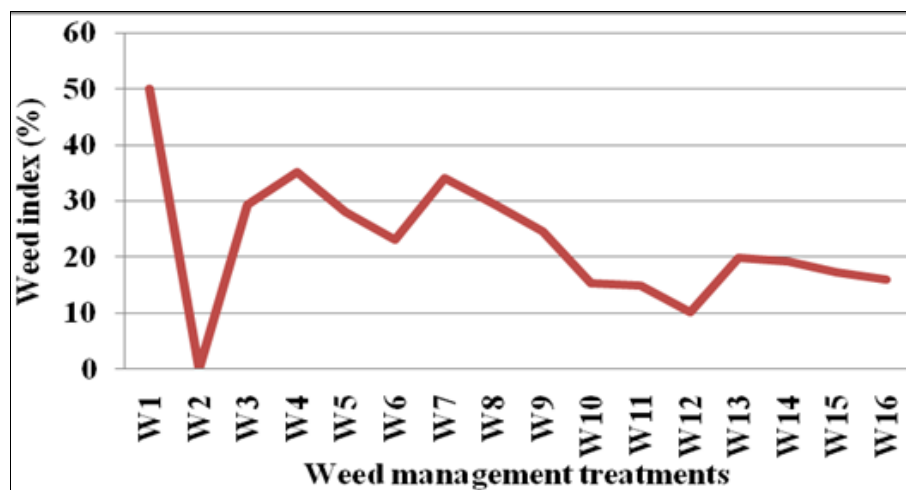


Fig. 3: Effect of weed management practices on weed index (%) in *rabi* maize

Summary

A field experiment conducted in the *rabi* season of 2021 at Assam Agricultural University, Jorhat using a randomized block design with 16 treatments to evaluate the effect of plant residue and extract on weed management in *rabi* maize. The treatment with *L. camara* extract (15%) spray at 15 DAS followed by one mechanical weeding at 30 DAS showed higher WCE and WCI. This was due to the highest inhibition in weed seeds' germination in the initial stage by *L.camara* extract (15%) and subsequent reduction in weed density and dry matter due to mechanical weeding at 30 DAS which enhanced dry matter accumulation/plant and cob yield with a lower value of WI under the mentioned treatment.

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