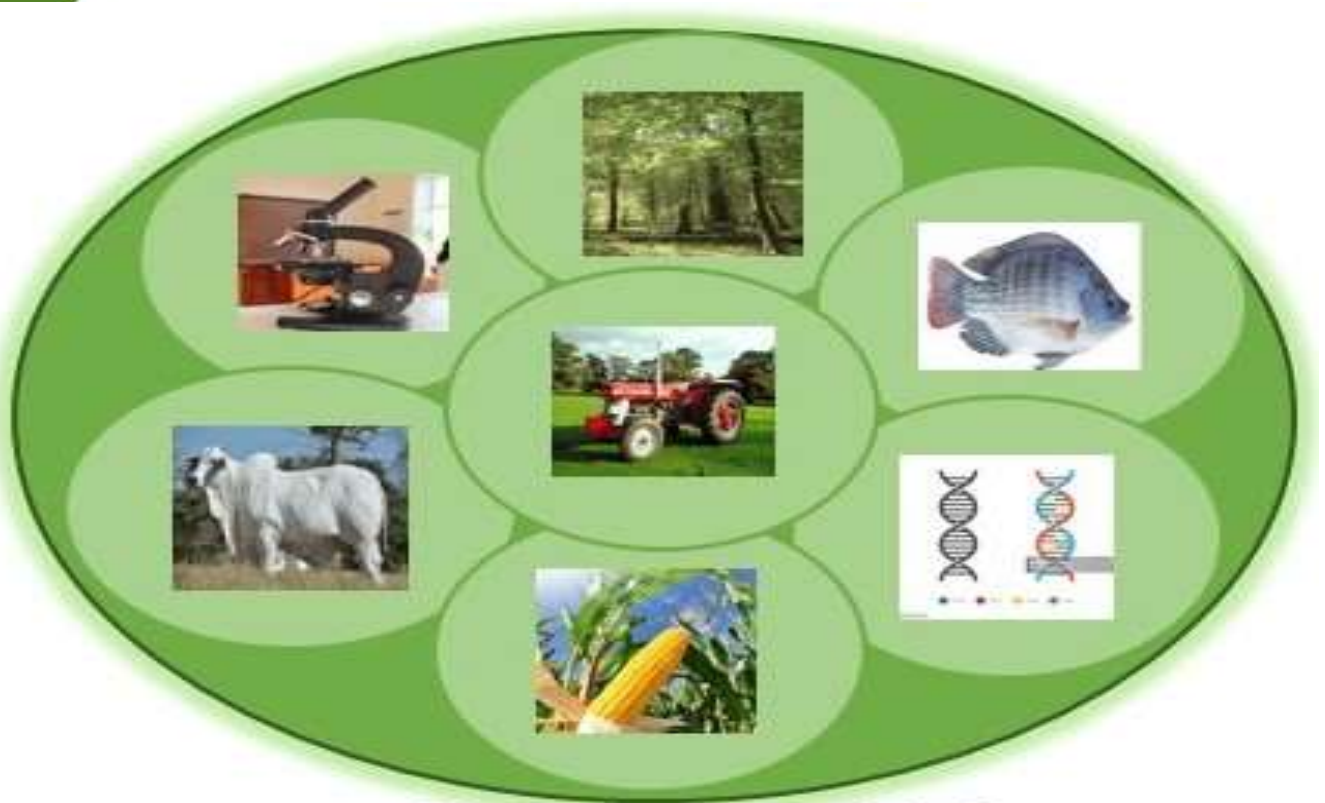




(KEJAANS)

KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES

September, 2025, Vol. 1, issue 2



KEJAANS

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ISSN: 1595-5776



KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES
(KEJAANS)

September, 2025; Volume 1, Issue 2

OFFICIAL JOURNAL OF THE
FACULTY OF AGRICULTURE
ABDULLAHI FODIO UNIVERSITY OF SCIENCE AND TECHNOLOGY,
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VARIOUS METHODS OF MANAGING STRIGA (*STRIGA HERMONTHICA*) IN COWPEA (*VIGNA UNGUICULATA*) AT MAIDUGURI INTERNATIONAL AIRPORT, BORNO STATE, NIGERIA

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ABSTRACT

Striga hermonthica, a parasitic weed native to sub-Saharan Africa, significantly hinders cowpea (*Vigna unguiculata* L. (Walp)) production by draining water and nutrients from host plants, leading to considerable reductions in yield. This research evaluated and compared the effectiveness of several *Striga* control strategies which include hand weeding, application of the pre-emergence herbicide imazapyr, and intercropping with maize on *Striga* infestation rates, cowpea growth, and grain yield at the Maiduguri International Airport farm during the 2022/2023 cropping season. Results indicated that plots treated with imazapyr and those intercropped with maize exhibited significantly lower *Striga* densities and enhanced cowpea growth and yield compared to hand weeding and untreated controls. These results advocate for the incorporation of chemical and cultural methods for effective *Striga* management to enhance cowpea production in the Sahel Savannah agro ecological region.

Keyword: *Striga*, Cowpea, Approaches, Management

Introduction

Cowpea (*Vigna unguiculata* [L.] Walp.) is one of the most important grain legumes grown in sub-Saharan Africa, where it provides a major source of dietary protein, fodder, and income for millions of smallholder farmers (Boukar *et al.*, 2018). Nigeria is recognized as the largest producer and consumer of cowpea worldwide, where the crop plays a vital role in addressing food insecurity and malnutrition (Singh *et al.*, 2021). Despite its significance, cowpea production is constrained by a range of biotic and abiotic stresses, with parasitic weeds of the genus *Striga* being among the most destructive (Rodenburg *et al.*, 2016). *Striga hermonthica*, commonly known as witchweed, is

particularly damaging to cowpea and other staple crops by attaching to host roots and siphoning water, minerals, and photosynthates, thereby severely stunting plant growth and yield (Abdulkadir *et al.*, 2020).

The infestation of *S. hermonthica* is especially acute in the Sahel and Sudan savannah zones of Nigeria, including Borno State, where the parasitic weed is favored by low soil fertility and erratic rainfall patterns (Atera *et al.*, 2018). Yield losses in cowpea due to *Striga* can range between 40–80%, and in severe cases, total crop failure may occur (Yohannes *et al.*, 2021). The persistence of *Striga* seeds in the soil seedbank, which may remain viable for more than a decade, further complicates its control

and management (Samejima et al., 2016). These challenges underscore the necessity for effective and sustainable management strategies tailored to local farming systems. Several methods have been developed to mitigate *Striga* infestation in cowpea. Mechanical control, such as hand weeding, is widely practiced by smallholder farmers; however, it is labor-intensive, often ineffective once *Striga* has emerged, and provides only temporary relief (Adewale et al., 2019). Chemical methods, particularly the use of pre-emergence herbicides such as imazapyr, have demonstrated strong efficacy in suppressing *Striga* seed germination and subsequent attachment to host roots (Kanampiu et al., 2018). Nonetheless, herbicide use may be constrained by cost, availability, and environmental concerns. Cultural practices, including crop rotation, intercropping, and planting of tolerant or resistant cowpea varieties, have also been shown to reduce *Striga* incidence while enhancing soil fertility and system resilience (Teka, 2016; Omoigui et al., 2021). Recent studies emphasize the superiority of integrated management approaches that combine chemical, cultural, and mechanical methods over single-control strategies (Midega et al., 2017). For example, intercropping cowpea with cereals such as maize can reduce *Striga* emergence by acting as a trap crop, while herbicide seed dressing can further suppress early parasitism (Sambo et al., 2022). Despite these advancements, localized research on the performance of different management strategies under the Sahel Savannah Agro ecological conditions of Maiduguri is limited. The unique soil and climatic conditions at the Maiduguri International Airport farm provide a suitable environment to evaluate these methods and their potential contribution to sustainable cowpea production in Nigeria.

Materials and Methods

Study Area:

Field trials were conducted at Maiduguri International Airport farm in Borno State, Nigeria (11.8443°N, 13.1609°E). The region has a Sahelian climate with a brief rainy season (June to September), receiving an average annual rainfall of approximately 700 mm, and characterized by sandy loam soils.

Experimental Design and Treatments

The treatments consisted of five *Striga* management strategies viz. T1: Control (No *Striga* management) T2: Hand weeding at 3 and 6 weeks after planting (WAP) -T3: Pre-emergence herbicide (imazapyr) applied at planting and T4: Intercropping cowpea with maize in a 1:1 row ratio Arranged in a randomised complete block Design with four replications.

Each plot measured 4 m × 5 m, with recommended cowpea spacing (60 cm × 30 cm). In treatment T4, maize was alternately planted with cowpea rows.

Crop Management

Certified cowpea seeds were sown at the onset of the rainy season. Imazapyr was applied pre-emergence at the recommended rate of 0.2–0.4 L ha⁻¹ (equivalent to 0.05–0.1 kg a.i. ha⁻¹). Standard fertilizer application and irrigation practices were uniformly maintained across all treatments. Hand weeding involved careful removal of emerged *Striga* plants at two intervals (3 and 6 WAP).

Data Collection

Striga Density: Counted as the number of emerged *Striga* plants per m² at 8 and 12 weeks after planting.

Cowpea Growth Parameters: Recorded plant height (cm) and number of pods per plant at the flowering stage.

Grain Yield: Collected at maturity and expressed in kilograms per hectare (kg/ha).

Statistical Analysis

Data collected were subjected to analysis of Variance using Data collected were subjected to analysis of variance (ANOVA) using SPSS version 25. Treatment means were separated using Duncan's Multiple Range Test (DMRT) at $P \leq 0.05$, and means followed by different letters were considered significantly different.

Results and Discussion

Striga Density

Table 1 presents the effect of different *Striga* management practices on *Striga* density in cowpea at Maiduguri International Airport. The results showed significant differences among the treatments.

The application of the pre-emergence herbicide (T3) resulted in the lowest *Striga* densities at both 8 and 12 weeks after planting, significantly reducing infestation compared to other treatments. Intercropping (T4) also effectively reduced *Striga* but was less effective than the herbicide. Hand weeding showed a moderate decrease in *Striga* density compared to untreated plot.

Table 1. *Striga* Density

Treatment	Striga Density at 8 WAP (plants/m ²)	Striga Density at 12 WAP (plants/m ²)
Control (T1)	15.2 a	21.5 ± 1.7a
Hand Weeding (T2)	10.7 b	16.3 ± 1.2b
Imazapyr 250 g/L T3)	2.5d	3.1 ± 0.5d
Intercropping (T4)	4.1 c	5.7 ± 0.7c
SE±	3.08	4.1

Means followed by different letters in columns differ significantly at $P \leq 0.05$.

At 8 WAP, the control plots recorded the highest *Striga* density (15.2 plants/m²), which further increased to 21.5 plants/m² at 12 WAP. This confirms earlier reports that, in the absence of control measures, *Striga* rapidly proliferates and severely competes with host crops for nutrients and water (Ekeleme *et al.*, 2020; Rubiales *et al.*, 2021).

Hand weeding (T2) reduced *Striga* density significantly compared to the control (10.7 plants/m² at 8 WAP and 16.3 plants/m² at 12 WAP). While this shows that physical removal is beneficial, the persistence of *Striga* even after weeding highlights the limitations of relying solely on manual control. Similar findings were reported by Alakonya *et al.* (2021), who noted that hand weeding can

suppress *Striga* temporarily but is labor-intensive and ineffective against underground attachments that continue to weaken the host plant.

Pre-emergence application imazapyr was most effective method, recording the lowest *Striga* densities (2.5 plants/m² at 8 WAP and 3.1 plants/m² at 12 WAP). This agrees with findings by Kanampiu *et al.* (2018) and Abate *et al.* (2020), who reported that imazapyr-treated crops significantly suppress *Striga* emergence by killing the parasite soon after attachment to the host root. The consistent reduction across growth stages demonstrates the long-lasting efficacy of chemical control in managing *Striga*.

Intercropping cowpea with maize (T4) also significantly reduced *Striga* density compared to the control (4.1 plants/m² at 8 WAP and 5.7 plants/m² at 12 WAP). This can be attributed to the “trap cropping” effect of maize, which stimulates suicidal germination of *Striga* seeds without supporting full development (Samejima & Sugimoto, 2018). Similar results were reported by Menkir *et al.* (2021), where intercropping reduced *Striga* infestation and improved overall system productivity.

Overall, the study proves that chemical (imazapyr) and cultural (intercropping) methods were more effective than hand

weeding in suppressing *Striga* populations. These results support integrated *Striga* management approaches that combine chemical, cultural, and manual practices to sustainably reduce infestation and enhance cowpea production in the Sahelian zone.

Cowpea Growth:

Cowpea plants in treatments T3 and T4 displayed notably greater height and pod counts at flowering compared to T1 and T2, which be attributed to decreased competition from *Striga* and improved availability of resources.

Table 2. Cowpea Growth:

Treatment	Plant Height at Flowering (cm)	Number of Pods per Plant
Control (T1)	32.5c	12.4 c
Hand Weeding (T2)	38.6b	15.8 b
Imazapyr 250 g/L (T3)	49.7a	22.5a
Intercropping (T4)	44.3a	19.7 a
SE±	6.24	4.4

Means followed by different letters in columns differ significantly at $P \leq 0.05$.

Growth and Yield Components of Cowpea under Different *Striga* Management Practices

The effects of different *Striga* management practices on plant height at flowering and the number of pods per plant are shown in Table 3. The results indicate significant differences among treatments ($p \leq 0.05$), reflecting the impact of *Striga* suppression on cowpea growth and reproductive performance.

Plant Height at Flowering

Cowpea plants in the control plots (T1) had the lowest height (32.5 cm), likely due to high *Striga* infestation (21.5 plants/m² at 12 WAP), which limits nutrient and water uptake, thereby restricting vegetative growth (Rodenburg *et al.*, 2016; Abdulkadir *et al.*, 2020).

Hand weeding (T2) increased plant height to 38.6 cm, indicating some alleviation of parasitic stress. However, residual *Striga* attachment still constrained full growth potential. Pre-emergence herbicide application (T3) produced the tallest plants (49.7 cm), demonstrating the effectiveness of chemical control in minimizing *Striga* parasitism and promoting vegetative development (Kanampiu *et al.*, 2018). Intercropping with maize (T4) also significantly enhanced plant height (44.3 cm), reflecting reduced *Striga* emergence through shading and trap cropping effects, consistent with findings by Samejima & Sugimoto (2018). Similarly, intercropping with maize (T4) significantly enhanced plant height (44.3 cm), reflecting reduced *Striga* emergence through shading and trap cropping

effects. This observation aligns with Samejima and Sugimoto (2018), who found that intercropping suppresses *Striga* emergence by reducing light penetration and stimulating suicidal germination of *Striga* seeds, thereby mitigating its parasitic effects on the host crop

Number of Pods per Plant:
A similar trend was observed for reproductive performance. Control plants produced the fewest pods (12.4), while hand-weeding increased pod number to 15.8 per plant. Imazapyr 250 g/L herbicide treatment (T3) resulted in the highest number of pods per plant (22.5), whereas intercropping (T4) also significantly improved pod production (19.7), indicating that both chemical and cultural approaches effectively mitigate *Striga* impact on yield components (Menkir *et al.*, 2021).

Overall, the results confirm a strong inverse relationship between *Striga* density and cowpea growth and yield components. Treatments that effectively reduced *Striga* populations (T3 and T4) maximized plant height and pod production, while hand weeding provided only partial benefit. These findings support the adoption of integrated *Striga* management strategies combining chemical and cultural methods to sustainably enhance cowpea productivity in the Sahel Savannah agro ecological zone.

Grain Yield:

Grain yield followed a similar trend as growth parameters, with T3 achieving the highest yield (1750 kg/ha), followed by intercropping (1500 kg/ha), both significantly outperforming hand weeding and control treatments.

Table 3. Grain Yield

Treatment	Grain Yield (kg/ha)
Control (T1)	910d
Hand Weeding (T2)	1125c
Pre-emergence Herbicide (T3)	1750a
Intercropping (T4)	1500b
SE \pm	13.63

Means followed by different letters in columns differ significantly at $P \leq 0.05$.

Conclusion

Utilizing Imazapyr 250 g/L and intercropping cowpea with maize are effective strategies for managing *Striga* infestation while enhancing cowpea growth and yield in Maiduguri's Sahelian conditions. These methods outperform traditional hand weeding and should be incorporated into local agricultural practices to improve cowpea productivity and food security.

Recommendations

- Promote the use of affordable, safe pre-emergence herbicides, along with training for farmers on proper application techniques.

- Encourage intercropping systems that disrupt the *Striga* lifecycle and enhance resource efficiency.

- Support research into developing cowpea varieties resistant to *Striga*, as well as biological control strategies that are tailored for the Sahel.

- Strengthen agricultural extension services to facilitate the dissemination and adoption of integrated *Striga* management technologies.

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