International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 09-07-2026, Accepted: 09-08-2026, Published: 24-08-2026
Volume 11, Issue 3, 2026, Page No. 313-317

An integrated low-cost visual, physical and auditory deterrent system for mitigating Indian peafowl (*Pavo cristatus*) and crane-induced crop damage in watermelon–coconut intercropping: A field study from Coimbatore, Tamil Nadu, India

Dr. John Yesudhas
Tech Farming Scientist, Founder and Chief Executive Officer, IGO Groups, Chennai, Tamil Nadu, India
Corresponding Author: Dr. John Yesudhas
DOI: https://doi.org/10.66856/ijbs.2026.11.3.11214

Abstract
Peafowl *(Pavo cristatus*) and crane damage to establishing seedlings is a widely reported constraint on smallholder cucurbit production across Tamil Nadu, yet few field-level trials document the efficacy of low-cost, farmer-assembled deterrent combinations under commercial intercropping conditions. This study reports a case-controlled field trial conducted on a 1.5-acre watermelon (*Citrullus lanatus*) crop intercropped with mature coconut (*Cocos nucifera*) at Karegoundapalayam, Coimbatore district, Tamil Nadu. During the first sowing cycle, 2,710 seeds were sown; sustained foraging by an estimated 15 peafowl and 5 cranes destroyed 1,500 seedlings by the fifteenth day after sowing, and only 64 plants (2.4% of seeds sown) survived to establishment by day 25, corresponding to a reported yield loss of up to 80%. In response, an integrated deterrent package was deployed, combining zigzag 6 mm nylon rope strung between coconut palms fitted with reflective ribbon and compact-disc (CD) flash strips, perimeter reflective spiral deterrents and wind spinners, four human-effigy scarers, and scheduled early-morning pyrotechnic (cracker) sound bursts, with rope geometry rotated fortnightly and scarer positions rotated every four days to counter habituation. Bird visitation ceased within three days of deployment. A second sowing of 2,750 seeds under the maintained deterrent regime achieved 2,720 germinated seedlings (98.9% germination), with the entire stand reaching the fruiting stage at the time of reporting. These results indicate that a rotated, multi-modal (visual + physical + auditory) deterrent system can rapidly and durably suppress peafowl- and crane-mediated seedling loss in open-field cucurbit–coconut intercropping without recourse to lethal or chemical control, offering a replicable, low-cost model for smallholder farms in peafowl-dense agro-ecosystems of peninsular India.

Keywords: Indian peafowl (*Pavo cristatus*), crop depredation, bird deterrent, reflective ribbon, watermelon, coconut intercrop ping, wildlife-crop conflict, Tamil Nadu

Introduction

Watermelon (*Citrullus lanatus*) is widely grown as a short-duration, high-value intercrop in the wide inter-row spaces of coconut (*Cocos nucifera*) plantations, where the palm canopy permits 50–60% light penetration to the ground and the perennial root system occupies only a fraction of the allotted land area (Reddy *et al*., 2004 [9]; PMC12301090, 2024). Such coconut-based cropping systems are widely promoted in Tamil Nadu and other peninsular Indian states as a means of intensifying land use, diversifying farm income, and improving soil health during the establishment phase of the palm (Padma *et al*., 2018 [8]; PMC12301090, 2024).

A major and increasingly reported constraint on establishment-stage cucurbit and cereal crops in this region is depredation by the Indian peafowl (Pavo cristatus), the national bird of India. Peafowl populations have expanded markedly over the last two decades in the absence of natural predators and under strict legal protection afforded by the Wildlife (Protection) Act, 1972, and farmers across Tamil Nadu, Telangana and Andhra Pradesh now rank peafowl among the principal vertebrate pests affecting sowing-stage crops (Deccan Chronicle, 2019; Down To Earth, 2024) [3, 4]. In the Erode and Coimbatore districts of Tamil Nadu specifically — the same agro-ecological zone as the present study — nearly two-thirds of the rural population depends directly or indirectly on agriculture, and peafowl-related crop loss has been identified as a source of significant economic distress to farmers (Anitha, Lalitha & Chandrasekaran, 2021) [1]. Because peafowl are large-bodied, intelligent, protected birds that cannot be culled or physically harmed, farmers must rely exclusively on non-lethal frightening and exclusion techniques (Anitha *et al*., 2021; Down To Earth, 2024) [1, 4]. Sympatric depredation by cranes and other large wading Birds compounds losses at seedling emergence, when cotyledons and young shoots are most vulnerable to pecking and trampling.

Non-lethal bird management in Indian field crops has traditionally relied on human vigilance, noise-making, scarecrows, and simple visual deterrents, but single-mode techniques are widely reported to lose effectiveness within days to weeks as birds habituate to a static, unchanging stimulus (Ahmad *et al*., 2018, cited in Zhang *et al*., 2024; Bomford & O'Brien, 1990) [2, 5]. Reviews of frightening-device efficacy consistently report that integrated systems combining visual, physical and auditory cues outperform any single technique, and that periodic repositioning or rotation of the stimulus is necessary to delay habituation in cognitively flexible species such as corvids and peafowl (Gilsdorf, Hygnstrom & VerCauteren, 2002, cited in review literature; Sofian, 2023) [10]. Reflective ribbon and compact-disc flash deterrents in particular have been shown, in replicated trials on wheat and maize in Punjab, Pakistan, to significantly reduce the abundance of pest bird species visiting a field (Hafeez *et al*., 2008) [6], while physical rope barriers strung at seedling height have been separately recommended by agricultural extension services as an effective low-cost method of reducing peafowl damage during crop sprouting (Deccan Chronicle, 2019) [3].

Despite this body of evidence for individual deterrent components, there is a lack of documented, quantified field trials that combine multiple deterrent modalities with a planned rotation schedule and report before-and-after seed, germination and survival data for a commercial cucurbit–coconut intercropping system in India. This paper addresses that gap by reporting a full production-cycle case-controlled trial from a 1.5-acre watermelon–coconut intercrop in Coimbatore district, in which an integrated rope-borne visual deterrent system, perimeter reflective devices, human effigies and scheduled pyrotechnic sound were deployed against a quantified peafowl and crane population, with rotation intervals set specifically to counter the habituation behaviour previously reported in this species. The objectives of the study were to: (i) quantify seedling loss attributable to peafowl and crane foraging in the absence of active deterrence; (ii) evaluate the speed and durability of bird-visitation suppression following deployment of the integrated deterrent package; and (iii) quantify germination and crop establishment outcomes under the maintained deterrent regime in a subsequent re-sowing.

Materials and Methods

1. Study site

The trial was conducted on a 1.5-acre (0.61 ha) commercial farm at Karegoundapalayam, Coimbatore district, Tamil Nadu, India, on which watermelon (*Citrullus lanatus*) was grown as an intercrop in the inter-row spaces of an established coconut (*Cocos nucifera*) plantation. Watermelon was raised on raised beds covered with black polyethylene mulch, with seed sown into planting holes punched in the mulch and irrigated via an inline drip system (Figures 1, 2 and 4). The site is bordered by scrub vegetation, coconut palms and mixed fruit trees, which was observed to provide cover and perching sites for local bird populations, including peafowl and cranes, adjacent to the crop.

2. Pest bird population

A resident population of approximately 15 Indian peafowl (*Pavo cristatus*) and 5 cranes was recorded foraging in and around the trial field over the course of the study, based on repeated farm-level observation counts by the farm management team.

3. Baseline (uncontrolled) sowing

An initial sowing of 2,710 watermelon seeds was completed across the 1.5-acre plot without any active bird deterrent measures in place. Seedling emergence and standing plant counts were monitored daily from day 1 (sowing) through day 25 after sowing, the period identified by farm staff as the principal window of vulnerability to peafowl and crane foraging on seeds, cotyledons and young shoots.

4. Integrated deterrent package

Following confirmation of severe seedling loss, an integrated, multi-modal deterrent system was designed and deployed across the full 1.5-acre plot, combining the following components:

- **Physical–visual rope barrier:** 6 mm nylon rope strung in a zigzag pattern between coconut palm trunks across the field, at a height intended to intersect the flight and walking paths of foraging birds (Figures 4 and 5).
- **Reflective flash elements:** 3–4 strips of holographic reflective ribbon tied along each rope run, together with two sets of suspended compact-disc (CD) reflectors, to produce unpredictable light flash under ambient movement and breeze (Figures 4 and 5).
- **Perimeter visual deterrents:** reflective spiral deterrent strips and reflective wind spinners installed around the field perimeter, outside the rope grid.
- **Human effigies:** four fabricated "man scarer" (scarecrow-type) figures distributed across the plot.
- **Scheduled auditory deterrent:** three pyrotechnic crackers discharged each morning at a fixed early-morning time coinciding with peak peafowl and crane field-entry activity.

To counter the well-documented capacity of peafowl for rapid habituation to unchanging stimuli (Ahmad *et al*., 2018, cited in Zhang *et al*., 2024) [12], two rotation protocols were built into the deployment: the zigzag rope pattern and reflective-element positions were reconfigured every 2 weeks, and the physical location of the four human-effigy scarers was changed every 4 days. Bird presence/absence in the field was monitored daily by farm staff following deployment.

5. Post-intervention re-sowing

After the deterrent package had suppressed bird visitation, the field was re-sown with 2,750 watermelon seeds under the continued (rotated) deterrent regime. Germination counts were taken at the standard germination-assessment interval, and crop growth stage was subsequently monitored through to fruiting.

6. Data recorded

The following data were recorded and are reported here: total seed sown per sowing cycle; number of seedlings/plants damaged or destroyed by birds and the day after sowing at which this was assessed; number of plants surviving to establishment; germinated seedling count and germination percentage for the post-intervention sowing; time (in days) from deterrent deployment to cessation of bird visitation; and estimated peafowl and crane counts in the field.

Results

1. Baseline seedling loss under uncontrolled bird pressure

In the absence of active deterrents, peafowl and crane foraging caused rapid and severe seedling loss. Of the 2,710 seeds sown, 1,500 seedlings (55.4% of seed sown) were recorded as damaged or destroyed by day 15 after sowing. Losses continued through the 25-day vulnerability window, and only 64 plants (2.4% of seed sown) remained established at the end of that period, consistent with the farm's reported yield loss of up to 80% for the affected crop stand (Table 1).

Table 1: Seedling loss under uncontrolled peafowl and crane foraging pressure, baseline sowing cycle.

Parameter	Value
Plot area	1.5 acre (0.61 ha)
Total seed sown (baseline cycle)	2,710
Seedlings damaged/destroyed by day 15	1,500 (55.4%)
Plants surviving to establishment (day 25)	64 (2.4% of seed sown)
Reported yield loss	Up to 80%
Estimated peafowl in field	15
Estimated cranes in field	5

2. Efficacy of the integrated deterrent package

Following deployment of the rope-borne reflective ribbon and CD-disc grid, perimeter reflective spiral and wind-spinner devices, four human-effigy scarers, and scheduled morning pyrotechnic sound, peafowl and crane visitation to the field ceased within three days. No further bird-related seedling damage was recorded following this point, provided the rotation schedule (rope/reflective-element pattern changed fortnightly; scarer positions changed every 4 days) was maintained.

3. Post-intervention germination and establishment

Under the maintained, rotated deterrent regime, the second sowing of 2,750 seeds produced 2,720 germinated seedlings, a germination rate of 98.9%. At the time of reporting, the entire established stand had progressed to the fruiting stage without further recorded bird damage (Table 2, Figures 1 and 2).

Table 2: Germination and establishment outcomes following deployment of the integrated deterrent package.

Parameter	Value
Total seed sown (post-intervention cycle)	2,750
Seedlings germinated	2,720
Germination rate	98.9%
Time to cessation of bird visitation after deployment	3 days
Rope/reflective pattern rotation interval	14 days
Scarer position rotation interval	4 days
Crop growth stage at reporting	Fruiting (full stand)

Field Documentation

Fig 1: Watermelon seedling at the cotyledon stage emerging through a mulch planting hole adjacent to the drip lateral, prior to full establishment of bird pressure.

Fig 2: Established watermelon seedlings at the true-leaf stage growing through mulch planting holes under the maintained deterrent regime, post-intervention sowing.

Fig 3: Close-up of a mulch planting hole showing a damaged/browsed young seedling adjacent to the drip emitter, illustrative of peafowl and crane feeding damage recorded during the baseline sowing cycle.

Fig 4: Zigzag rope grid strung between coconut palms across the intercropped rows, fitted with holographic reflective ribbon and suspended compact-disc (CD) flash deterrents, deployed as the primary visual-physical barrier component of the deterrent package.

Fig 5: Detail of reflective ribbon flash deterrents suspended from the rope grid within the coconut canopy at the field perimeter.

Discussion

The results of this trial are consistent with, and extend, the existing evidence base on non-lethal peafowl and bird-pest management in Indian field crops. Anitha, Lalitha and Chandrasekaran (2021) [1], working in the same Erode–Coimbatore agro-ecological belt of Tamil Nadu, similarly identified peafowl crop depredation as a source of major economic loss to farmers and argued for an interdisciplinary, eco-friendly deterrent approach rather than lethal control, which is precluded by the species' protected status. The present trial operationalises that recommendation at field scale and quantifies its effect: bird visitation ceased within three days of deployment, and subsequent germination recovered to 98.9%, compared with an effective survival rate of only 2.4% of seed sown under baseline, unprotected conditions.

The individual deterrent components used here are each independently supported in the literature. Hafeez *et al.* (2008) [6], in a replicated two-month trial on wheat and maize in Punjab, Pakistan, found that reflective ribbon suspended over the crop significantly reduced the abundance of four major pest bird species, a finding mirrored by broader reviews reporting reflective compact discs and high-visibility reflective tape among the most effective visual frightening devices tested against pest birds at a semi-industrial site in Southeast Asia (Efficacy of Several Types of Pest Bird Deterrents, 2024) [5]. Physical rope barriers strung at seedling height have likewise been specifically recommended by agricultural extension authorities in Telangana as a practical means of reducing peafowl damage during crop sprouting (Deccan Chronicle, 2019) [3], consistent with the rope-grid component deployed in this study. The addition of scheduled pyrotechnic sound and rotated human effigies reflects the broader finding, from reviews of frightening-device efficacy, that combinations of visual and auditory techniques deter a greater proportion of birds than either modality alone (Sofian, 2023) [10].

A central design feature of the present deterrent package — and one that appears to distinguish it from many single-technique interventions reported in the literature — was the planned rotation of both the rope/reflective-element pattern (every two weeks) and the scarer positions (every four days). This was implemented specifically because peafowl are behaviourally flexible and capable of learning that an unchanging visual or physical stimulus poses no real threat, a habituation effect widely documented for static scarecrows, reflective tape and other frightening devices left in a fixed configuration for extended periods (cited in Zhang *et al*., 2024; Bomford & O'Brien, 1990) [2, 12]. The sustained, three-day suppression of bird visitation observed here, without any subsequent breakthrough in bird activity for the remainder of the reported cropping cycle, is consistent with the hypothesis that periodic re-randomisation of deterrent stimuli Delays or prevents the habituation that limits the useful life of static devices.

From a practical standpoint, the deterrent package described here relies exclusively on locally available, low-cost materials — nylon rope, reflective ribbon, discarded compact discs, wind spinners and hand-fabricated scarecrows — together with farmer labour for periodic repositioning, and does not require chemical repellents, netting, all of which are either costly, impractical over 1.5 acres of palm-shaded intercrop, or legally precluded given the peafowl's protected status under Indian wildlife law. This makes the approach directly transferable to other smallholder coconut-based cucurbit or vegetable intercrops in peafowl-dense districts of Tamil Nadu, Telangana, Karnataka and Andhra Pradesh, where similar crop-bird conflict has been documented (Down To Earth, 2024) [4].

The study has several limitations that should be noted. First, it was conducted as a single-site, single-season, before–after (baseline versus post-intervention) field trial without a concurrent untreated control plot, so the observed recovery in germination and establishment cannot be fully separated from possible seasonal or environmental differences between the two sowing cycles. Second, peafowl and crane counts were derived from farm-level observation rather than systematic point-count survey methodology, and bird identification (particularly of the "crane" category) was not confirmed by species-level ornithological survey. Third, the trial reports outcomes through the fruiting stage but does not report final harvested yield or economic return. Future work should incorporate replicated, spatially separated control plots, systematic bird census methodology, and full harvest-yield and cost–benefit data, in order to more rigorously isolate the effect of the deterrent package from other seasonal factors and to quantify its economic return on investment for smallholder adoption.

Conclusion

Uncontrolled peafowl and crane foraging destroyed the great majority of a watermelon crop intercropped with coconut on a 1.5-acre farm in Coimbatore district, Tamil Nadu, reducing plant establishment to only 2.4% of seed sown and producing a reported yield loss of up to 80%. Deployment of an integrated, low-cost, non-lethal deterrent package — combining a rotated zigzag rope grid fitted with reflective ribbon and compact-disc flash elements, perimeter reflective spiral and wind-spinner devices, human-effigy scarers, and scheduled early-morning pyrotechnic sound suppressed bird visitation within three days and supported a subsequent germination rate of 98.9% and full crop establishment to the fruiting stage. The rotation of deterrent geometry and scarer position at fixed intervals appears to have been important in sustaining this effect against a behaviourally adaptive, legally protected pest species. This model offers a practical, replicable, and legally compliant approach to peafowl- and crane-related crop protection for smallholder coconut-based cucurbit intercropping systems across peninsular India, and warrants further evaluation under replicated, controlled field trial conditions.

References

1. Anitha S, Lalitha K, Chandrasekaran V. Peacock repellant technique for crop protection in the agricultural land. In: Agrawal S, Kumar Gupta K, Chan JH, Gupta M, editors. Machine Intelligence and Smart Systems, Algorithms for Intelligent Systems. Springer, 2021.
2. Bomford M, O'Brien PH. Sonic deterrents in animal damage control: A review of device tests and effectiveness. Wildlife Society Bulletin,1990:18(4):411–422.
3. Deccan Chronicle. National bird turns an eyesore for Telangana farmers. Deccan Chronicle, 2019.
4. Down To Earth. Researchers quantify damage caused by peafowl to farmers. Down To Earth / India Science Wire, 2024.
5. Efficacy of Several Types of Pest Bird Deterrents and General Trend of Pest Birds at an Industrial Factory. PMC12017283. National Center for Biotechnology Information, 2024.
6. Hafeez S, Khan TH, Khan TN, Shahbaz M, Ahmed M. Use of reflector ribbon as a pest birds repellant in wheat and maize crop. Journal of Agriculture and Social Sciences,2008:4:92–94.
7. Kale M, Dudhe N, Kasambe R, Bhattacharya P. Crop depredation by birds in Deccan Plateau, India. International Journal of Biodiversity,2014:2014:947683.
8. Padma E, Sujatha S, Bhat R. Nut yield and economics of coconut-based cropping/farming systems. Journal of Plantation Crops,2018:46(2):91–99.
9. Reddy DV, *et al*. Intercropping in oil palm plantations in India: prospects and constraints. Indian Coconut Journal,2004:35:12–18.
10. Sofian S. Review of effectiveness of visual and auditory bird scaring techniques in agriculture. ResearchGate preprint, 2023.
11. Wang S, Curtis P, Lassoie J. Farmer perceptions of crop damage by wildlife in Jigme Singye Wangchuck National Park, Bhutan. Wildlife Society Bulletin,2006:34(2):359–365.
12. Zhang Y, *et al*. An experimental study of acoustic bird repellents for reducing bird encroachment in pear orchards. Frontiers in Plant Science,2024:15: 1365275.
13. Synergizing sustainability: Integrated nutrient management and intercropping for optimal coconut cultivation in South India. PMC12301090. National Center for Biotechnology Information, 2024.