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Comparative Effectiveness of some Mechanical Repellents for Management of Rose Ringed Parakeet (*Psittacula krameri*) in Citrus, Guava and Mango Orchards

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ABSTRACT `

This paper reports on the effectiveness of the mechanical repellents employed against the management of rose-ringed parakeet (*Psittacula krameri*) in citrus, guava and mango orchards. All the three fields were sub-divided into three sections, left, middle and right. More damage occurred on the corners than in the middle. For the mango, the most effective repellent was the reflecting ribbon, reducing the depredations to (0.103%), while acetylene exploder was the least effective with the damage profile 0.237%. More or less comparable damage to all three fruits was reported using other mechanical repellents. For the citrus, the reflecting ribbon, yet again, proved to be most effective in inhibiting parakeet attacks, while in guava, the gas exploder was augmented to be the optimum in limiting the parakeet depredations, with maximum damage recorded with the multi-mirror reflectors. The present results indicated that, of the non-chemical techniques, unquestionably, the repellents proved highly beneficial in reducing the damage proportions and their rational use on some other fruit and cultivated crops should be manifested with to restrain the considerable economic losses in the unprotected conditions.

Key Words: Rose-ringed parakeet; Repellents; Orchards; Cultivated crops

INTRODUCTION

Of the orchards, mango, guava and citrus are considered as most important, widely cultivated in Pakistan. Although a variety of causes can be cited for their lower yields, one of the major is the injurious impact by birds and of these, the rose-ringed parakeet accounts for significant depredations (Khan & Beg, 1998; Iqbal *et al.*, 2001). In the agricultural fields throughout the world, damage by the granivorous birds is fairly substantial and therefore, requires appropriate management practices (Weatherhead *et al.,* 1982). Availability of suitable farm crops and orchards near the roosts of many bird pests not only offer a trouble free food, but also a sufficient protection.

For the cultivations in both Pakistan and India, frequent occurrence of the multiple cropping practices, extended over relatively small areas (about 12.5 acres), facilitate local farmers largely, but also provide plentiful feeding opportunities to several birds, resulting not only in abundant feeding, but also in economic losses (Khan & Hussain, 1990; Gupta *et al*., 1998; Malhi *et al*., 1998). Without any doubt, such crops attract a large number of birds *viz*., the rose-ringed parakeet, house crows, sparrows, mynas and starlings, only predating them, but also spoiling much more than their actual consumption (Akande, 1986). The rose-ringed parakeet, having acquired the status of a worst avian pest in the previous century mainly due to the suitable cropping patterns viz. maize, sunflower, wheat, mango, citrus, guava, dates and trees *Salmalia malabarica, Cedrella toona, Fucus bengalensis, Dalbergia sissoo, Terminalia arjuna* and *Eugenea cumini*, to acquire roosting and nesting opportunities (Shivanarynan *et al.,* 1981; Babu & Muthukrishnan, 1987; Roberts, 1991). Predominantly, the canal side forest plantations, city road avenues, roadside forests, crevices in the buildings and urban gardens, serve as the roosts and nests for this parakeet (Beg, 1978; Ali *et al.*, 1981; Shafi *et al*., 1986; Iqbal *et al*., 2001).

Traditionally, the use some bird repelling devices as beating of metallic drums, erecting the frightening models in crops and loud calls by farmers in the fields, have been frequently employed in Pakistan, but with a minimum success. No synchronized management measures have been tried here to inhibit its depredatory attacks, possibly due to the complexity exhibited by the aerial mode of life (Fiedler *et al*., 1991). As various frightening devices are an integral to repel the bird pests from food sources, they include those

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of the pyrotechnics, acoustic stimuli, gaseous exploder, reflecting tapes and lasers. Their effectiveness depends on the number of pest populations in a given area crop and the exactness of the installed device (Gilsdorf *et al*., 2002). According to Subramanya (1994), short roost distance from food crops increased the rate of depredations to the crops and livestock farms by non-random foraging, resulting in an overwhelming damage and substantial economic losses. Comparable reports have also been provided by Hussain *et al.* (1992), Mathur (1993), Beg *et al.* (1995), Malhi (2000) and Day *et al.* (2003), with each emphasizing on their effective and sustainable control in terms of food crops and local field conditions. Present studies were aimed at ascertaining the comparative effectiveness of some non chemical (repellents) devices in the three economically significant fruits viz. citrus, guava and mango, to alleviate depredations and reduce economic losses. It was anticipated further that, the same may also hold good to the other agricultural crops to restrain the parakeet damage and resultant economic losses.

MATERIALS AND METHODS

Present studies were undertaken in the selected agricultural farmlands, University of Agriculture, Faisalabad, Pakistan. Mechanical repellents included distress sound players, frightening kites, helical balloons, wind powered hawk eye rotator, reflecting ribbons, multi-mirror reflectors and gas exploder. A reflecting ribbon is a simple iridescent foil tape, with a luminous bright reflection, comprising of a polypropylene metallic surface, to parakeets away from the field crops, with a constant ripple effecting sunlight. The ribbons were hinged together at a sufficient height and evenly spaced (about 3.05 cm) for orchard fruits with the wooden bamboos. In each fruit field, 30 bamboos were inserted in soil, at the corners and center, to hold the ribbons firmly to produce the tensile strength for the maximum reflection to keep away the visiting parakeets. Bird scaring models includes, frightening kites, helical hawk eye balloons and wind powered hawk eyes rotators, were combined to visualize their joint effect and installed at equal distances in the garden. The multi-mirror reflectors**,** provided with an adjustable steel pipe equipped with an electric motor for their circular rotation. A charged reflector holds well for about 16 h and a speed of 7 rpm. The shining reflection helps in repelling the birds, when placed on the corners and centre of the field. The distress sound players were the alarm callers, when placed near the garden amplifying the fearsome sounds (explosions) to disperse the birds at frequent intervals. The orchard fields were divided equally in to three sections as the left corner, middle and right corner, respectively to better visualize the parakeet depredatory movements. All the repellents were employed in the orchard fields consecutively for five days each to obtain their impact.

Observations were extended throughout the day to assess the damage profile. Number of fruits recorded for damage were both attached and dropped. It is worth pointing out that, only such fruits were considered, with an unusual damage (deep & sharp incisors cut). The damaged fruits in the respective orchard fields were removed during the evening, to do away with any probability of mixing with numerical counts, the following day. Overall, their percentage damage was estimated.

The data so obtained was quantified and analysed using Kolmogrov-Smirnov Test (KS-goodness of fit test), to check its normality distribution in the minitab (version 2000) and the one-way analysis of variance (Steel & Torrie, 1980), to find out the significance of means and the differences among three sections of the respective fruit fields for the monthly samples and finally to determine the efficiency of management devices in terms of parakeet management.

RESULTS

Information with regard to mean squares using the single or one way ANOVA to know fruit damage percentage are presented in Table I. For the mango, a significantly higher (P<0.05) damage percentage was recorded in July as compared to that in August, 2009. Percent fruit damage also recorded a significant difference among three field sections in the mango field. It is evident from the data that, the highest percentage damage seemed on the right hand corner, 0.212±0.015, followed by 0.180±0.014, on the left hand corner and minimum, 0.146±0.013, recorded in the middle. Monthly variations in the data were also significant (P <0.05) for the fruit damage percentage. Certainly, there was more damage, 0.189±0.013, in July, while it reduced to 0.170±0.013 in August.

For the management devices, there also occurred significant (P <0.01) differences among them with respect to their efficiency. Acetylene exploder proved to be the least effective in managing the *P. krameri* attacks, 0.24±0.02, followed by the distress sound player, 0.21±0.01, gas exploder 0.18±0.01, multi-mirror reflectors, 0.18±0.01, bird scaring models, 0.18±0.01 and most effective in terms of fruit damage control was observed where reflecting ribbons, 0.10±0.012 were used (Table I).

In citrus garden, the left hand side section of the orchard exhibited more damage percentage depredations, 0.22±0.01, while for the right side and middle it was 0.20±0.01 and 0.17±0.01, respectively. There was a non-significant (P>0.01) monthly interactions between both of the months. By far, the repellents proved to be more effective and highly significant (P<0.01) in the present studies to reduce the damage on fruits. Acetylene exploder was recorded to be lowest in terms of inhibiting parakeet attacks, 0.26±0.011, while the reflecting ribbons showed the highest protection against parakeet visitations, 0.12±0.007 (Table I). Variation among the controlling devices depicted highest efficiency of ribbons, 0.121±0.007, respectively tracked by the mirror reflectors, 0.174±0.008, gaseous

Table I: Damage (%) caused by the rose-ringed parakeet three fruit species in an agro-ecological system in a fruit garden

Treatments	Sub- treatments	Damage (%) on fruits		
		Mango	**Citrus**	**Guava**
Field Sections	Left side trees	0.180±0.014 b	0.216±0.015 a	0.742±0.045 a
	Middle trees	0.146±0.013 c	0.174±0.012 b	0.427±0.025 c
	Right side trees	0.212±0.015 a	0.195±0.016 ab	0.670±0.034 b
Months	First	0.189±0.013 a	0.199±0.012 a	0.639±0.053 a
	Second	0.170±0.013 b	0.191±0.012 a	0.587±0.031 a
Management Devices	Dis. sound player	0.205±0.010 ab	0.213±0.020 b	0.686±0.089 ab
	Scaring models	0.175±0.014 b	0.205±0.010 bc	0.647±0.073 bc
	Mirror reflectors	0.178±0.018 b	0.174±0.008 c	0.745±0.081 a
	Acetylene exploder	0.237±0.022 a	0.259±0.011 a	0.585±0.060 c
	Refl. ribbons	0.103±0.012 c	0.121±0.007 d	0.555±0.051 c
	Gas exploder	0.179±0.017 b	0.200±0.012 bc	0.462±0.049 d

Means ± SE, sharing similar letters in a cell are statistically non-significant ($P > 0.05$)

Table II: Analysis of variance for fruit damage by the rose-ringed parakeet in three fruit species

Source of variation	Degree of freedom	Mean squares		
		Mango	**Citrus**	**Guava**
Field Sections	2	0.0131679**	0.0053257**	0.326583**
Months (M)	1	0.0033737*	0.0006003^{NS}	0.023932^{NS}
Devices (D)	5	0.0117214**	0.0125783**	0.061077**
Interaction	5	0.0001665^{NS}	0.0004082^{NS}	0.010652^{NS}
(MxD) Error	22	0.0007236	0.0006273	0.005596

NS = Non-significant (P>0.05),* = Significant (P<0.05),** = Highly significant (P<0.01)

exploder, 0.200±0.012, scaring models, 0.205±0.010, distress sound players, 0.213±0.020 and acetylene exploders, 0.259±0.011 (Table II).

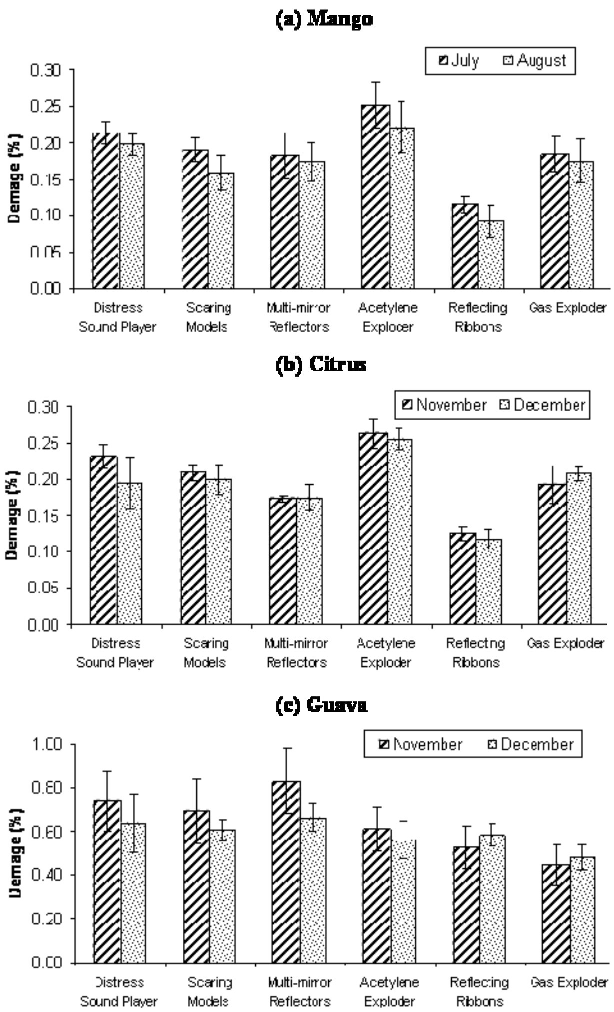
In guava orchard, there was also a highly significant (P<0.01) difference for three field sections, with the left corner being more susceptible to parakeet depredations, 0.742±0.045, the right ranked next, 0.670±0.034 and lowest in the middle, 0.427±0.025. The data however, presented a non-significant (P>0.01) variations for two monthly samples; November and December. For the device efficiency, a highly significant (P<0.01) proportion occurred amongst themselves; however, a non-significant ratio (P>0.01) existed (Table I). Of these, the gas exploder was most effective, 0.462±0.050; while the rest were in the order, ribbons, 0.555±0.061; acetylene exploders; 0.585±0.060; distress sound player, 0.647±0.073; bird scaring devices, 0.686±0.089 and mirror reflectors being the minimum, 0.745±0.081 (Table II). Monthly comparison of the management devices has been presented in Fig. 1. Apparently, in mangos, the reflecting ribbons were the most effective to deter the parakeet attack and acetylene exploders were the least successful. In citrus, almost an equivalent trend followed, whereas for the guava, a variable control was recorded, as the gas exploder served as the most protective; while the mirror reflectors, furnished the lowest management to parakeets.

The results of the present studies indicates that, for three fruit orchards, there existed a significant (P<0.05) interaction among three field sections, in relation to the fruit damage proportion. Depredatory visitations of the rose-ringed parakeet on the closely located orchards continued intermittently during the day. Apparently, more damage took place on the corners than in the centre. As earlier pointed out, the entire orchard fruit fields were equally split into three parts, for a comparison of depredation intensities and also for a better view of the field. In all, six mechanical repellents were incorporated for management of fruit crops. For mango in July and August, the reflecting ribbons proved to be highly effective in reducing rose-ringed parakeet visitations. Of the others, the acetylene exploders were nearly negligible in dropping the bird attacks on mango.

DISCUSSION

From the present studies, it is apparent that, the reflecting ribbons, due to the sharp and shining reflection, proved to be highly effective in repelling the birds from the cropped areas. This not only protected the orchards from the parakeet depredations, but also averted in considerable economic losses. Moreover, the present methodologies may also be beneficial for managing other avian pests. The distance of ribbons, about 3.05 m, sufficiently reduced the parakeet depredatory attacks on all three orchards. Of the other management devices, acetylene exploders proved to be least effective, possibly due to the fact that, they have traditionally been used by the farmers in the plains, as such, the birds turn to be habitual to them. Present work corresponds well with previous studies incorporating the reflecting ribbons (Bruggers *et al.*, 1986; Dolbeert *et al.*, 1986; Beg *et al.*, 1995). However, the blackbird pillage remained persistent in the presence of reflecting ribbons, possibly due to their non-impact o ribbons in but the pillage by the blackbirds. Findings of Canover and Dolbeer (1989), who reported that, blackbirds infestation did not reduce, conceivably due to large ribbon installation in the field. In present work, the ribbons were only 8-10 ft apart throughout the mangos, and substantially minimized the parakeet attacks. For citrus, incorporation of the same devices, led invariably to the comparable outcome, as that of mangos (Table I). Effectiveness of a particular device also depends largely on how well a specific device has been installed in the field, the distance a bird needs to travel to reach the food source, the population size and predilection to the crops, are

Fig. 1: Comparative fruit damage in the three fruits with different management devices (repellents)



mandatory ecological considerations for a better management (Swihart, 1992).

Although, quite a few management devices have been used lately to inhibit the bird damage to cropped areas, the most suitable are the ones, laying the maximum emphasis on the type of food crop, dimension of the field and exactness of installment (Kanis *et al.*, 2008). For guava, the gas exploder was the most proficient in minimizing the potential rose-ringed parakeet depredations. On contrary, the reflecting ribbons ranked next in reducing the depredations, and least being the mirror reflectors. The gas exploders also proved useful to scare away the invading bird attacks on the different food crops in California Plains, United States (Stevens & Clarke, 1998).

An important ecological consideration for all the management practices is to safeguard the integrity of the food sources in the agro-ecosystems. Any of their hazardous effect might disrupt the stability and sustainability of these self sustaining agro-ecological systems. Occurrence of avian pests is a constant threat to the agricultural and horticultural themes (Hughes, 1996). On many instances, farmers have to suffer the brunt of damage with resultant economic losses by the bird onslaught.

In Pakistan, situation can be more distressing, due to the paucity of work on avian pest management. Some attempts made in this (Khan & Ahmad, 1983; Khan & Hussain, 1990; Hussain *et al*., 1992; Beg *et al*., 1995) on the ring-necked parakeet, provided some beneficial information, but remained inconclusive. Future studies, it is earnestly anticipated that, future studies on the same lines, may prove productive with regard to other food crops in the region and the country, to maximally do away with the crop damage and economic loss by the parakeets and other avian pests, to improve the quality of crops and enhance the remunerations to the farmers and national economy.

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