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THE FOOD-SEARCHING AND FORAGING BEHAVIOURS OF RUFOUS TURTLE DOVE, STREPTOPELIA ORIENTALIS (LATHAM), IN SOYBEAN FIELDS

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ABSTRACT

Soybean seeds and cotyledons suffer great damage by the Rufous Turtle Dove in Japan, depending upon the time of seed sowing. In our experimental field at Tsukuba, in 1983, almost all plants were eaten until the middle of May.

Doves concentrated in fields where soybean seeds had been planted from the late April to the middle of May. After the middle of May, they came to the fields where wheat and barley had just been cut or the soils had been ploughed.

Experiments conducted in the field covered with a large cage and utilizing the same doves showed that the rate of attacking new food (i.e., soybean buds) by doves increased with their experience to eat that food. Doves also frequently return to sites where food had once existed.

These results suggest a practical method for avoiding damage by doves: sowing of soybean seeds in fields after the harvesting of wheat or barley. At these times greater effects also will be obtained from bird repellent devices.

INTRODUCTION

In recent years, especially since the 1970's, bird damage to soybeans has become a serious problem in Japan. During this time the government has encouraged farmers to cultivate soybeans in the fields converted from paddy in order to decrease the excess rice production. However, an increase in soybean cultivation is hampered by many factors; one of the most important is the damage from birds. Several kinds of birds attack soybean seeds and cotyledons in their seed and budding stages, so that plants are killed or produce small yields. In the heaviest cases, nearly 100% of the plants are damaged.

Although many birds attack the soybean, the Rufous Turtle Dove, *Streptopelia orientalis* (Latham), and feral pigeon, *Columba livia* var., are the most important species. The former dominates in the countryside and montane regions and the latter in the suburbs of cities. The biology and foraging ecology of these species has been studied by several authors (e.g., Abe, 1979; Utsunomiya and Takeda, 1980; Murakami and Fujimaki, 1983). Matsuda and Yanagida (1978) showed that the damage by doves and pigeons is concentrated in a short period, such as the week or 10 days after bud (cotyledon) appearance. It has been observed by some authors (e.g., Nasu and Matsuda, 1976) that the damage of soybean plants greatly fluctuates depending upon the time of seed sowing.

In this paper, we try to analyze mechanisms causing fluctuations in damage to

soybeans from *S. orientalis*. This analysis necessitates that we determine the food-searching process and foraging behaviour of this species.

METHODS

The Fluctuations in Damage

In order to know the seasonal fluctuations in the damage intensity by doves, soybean seeds were sowed biweekly in plots of 1 a (are = 1/100 ha) in the experimental field at the National Agriculture Research Center, Tsukuba, from mid-April to the end of August. The number of soybeans damaged by doves was counted every morning after the cotyledons appeared above the soil.

The number of doves coming to this field was counted daily at 0800 from mid-April to the end of July. Further, the number of doves coming to the plots in the experimental field, totaling 20 ha, was counted every hour from early morning to dusk biweekly. At the same time, the kinds and state of crops in the field where doves came were recorded. If there were no crops in the field, it was placed in one of two categories: the bare field where the soils had been cultivated and the field where the wheat, barley, or corn had just been cut and parts of plants and dropped seeds remained.

The Experiments in the Flight Cage

In order to determine the effect of past experience of doves on the selection of food sites, an experiment was conducted in a large flight cage, 40 x 60 x 12-m (H). The soybean seeds were sowed in a field in this cage every two or three days for a total of six times. Seven doves were introduced into the cage, and the number of plants damaged was counted every day.

Another experiment was carried out to reveal whether doves have a long or short memory of the site where the food had once existed. The soybean seeds were placed on soil-filled containers of 62 x 70-cm on the first day. From the second to the sixth day, the seeds were removed; on the seventh day they were replaced. At the same time a certain area (62 m x 70-cm) with no soybeans 24 m away from the food placing site was selected as a control. The doves visiting these sites were recorded on video-tape with a TV-camera over eight hours. Later the total number of doves visiting such site and the total visiting times were obtained from the video-tapes.

The Experiments for the Effect of Repellents

In order to know the effect of two kinds of repellents on the decrease in the dove damage to soybeans, two experiments were conducted in May 1983. A field of 3 a (3/100 ha) was divided into nine blocks and three different treatments (i.e., Repellent A, Repellent B and control) with three replications of each were arranged within these blocks in the form of Latin squares. Both of these repellents are mixed with coloring matter which dyes the cotyledons red or green. After the seeds were soaked in the original solution of each repellent, they were dried in the shade and then sown. The number of plants damaged was counted every morning from the beginning of bud appearance to the cessation of damage.

RESULTS AND DISCUSSION

Figure 1A shows the seasonal fluctuations in the percentage of plants damaged in 1983. Almost all plants were eaten by doves until mid-May, but the damage began to decrease thereafter. It became nearly 0% by mid-June and continued to the end of the month, but began to increase thereafter.

Roughly the same pattern in the fluctuations of damage had also been obtained from 1980 and 1982 in our experimental field at Tsukuba. A similar decrease in the damage is also observed in several other places in Japan, although the periods and times of the occurrence are different. As this time coincides with the wheat and barley harvests, it has been thought by some authors (e.g., Nasu and Matsuda, 1976) that a supply of foods preferable to doves, such as wheat and barley seeds, diverts them from attacking soybeans.

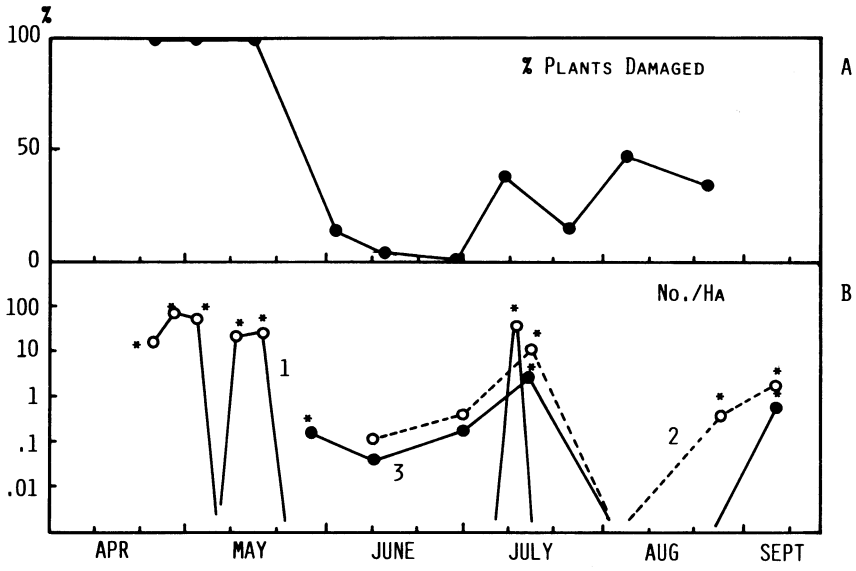

FIGURE 1. (A): Seasonal fluctuations of percentage of soybean plants damaged in 1983, Tsukuba. (B): The number of doves per ha visiting soybean fields (1), fields where wheat, barley or corn had just been cut (2), and bare fields where soils had been ploughed (3). Numbers with asterisks are significantly higher than the expected number when doves come to these fields only by chance.

As seen in Figure 1B, doves aggregated at the field where soybean seeds had been planted from late April to mid-May. The number of doves coming to these fields is significantly higher than the expected number if they were to visit these fields only by chance, according to the proportion of the area of these fields to the whole. However, doves were not observed in the soybean fields after mid-May (except in mid-July). Contrarily, from the end of May more doves were observed in the no-crop fields where wheat and barley had been cut or soils cultivated. This time roughly coincides with the decrease in the damage to soybeans.

The numbers of doves coming to no-crop fields were always significantly higher except in June, suggesting that they visit preferentially fields not covered with crops or weeds. If this is true, this behaviour is very adaptable for them because large amounts of crop or weed seeds can be found in these fields.

As seen in Figure 1A, the percentage of plants damaged reached almost 100% in the first three points. However, the rate of attack (or the rate of increase in damaged plants per day) increased from the first to the second times. This also was true in the experiments in other years, suggesting that doves gradually become familiar with new foraging sites and/or new kinds of foods.

Figure 2 shows the experimental results conducted in the fields covered with a large cage where the same seven doves were kept. The seeds were planted at two or three-day intervals. As seen in this figure, the rate of attack increased over time. As the fields were easily found by doves living in this cage, this increase in the attack rate was caused mainly by the doves' acclimation to eating soybean plants.

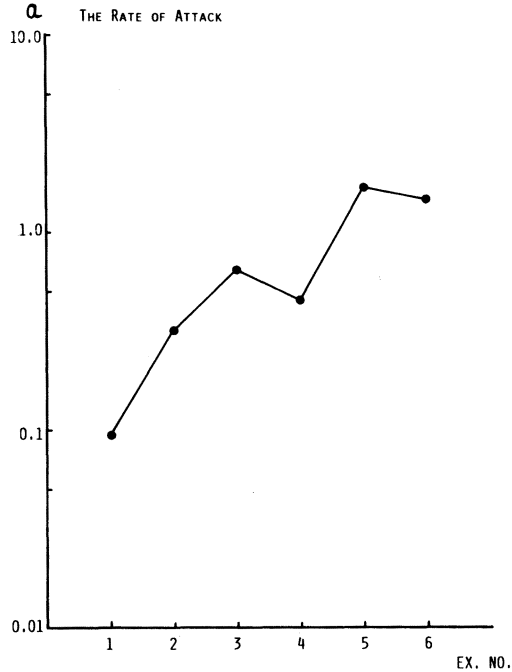

FIGURE 2. The rate of attack in doves when soybean seeds were sowed sequentially in the same field at intervals of two to three days (from Ex. 1 to Ex. 6).

At the same time, they also have a trend of visiting sites where food had been found at previous times. Figure 3 shows the total visiting time of doves and the number of visits to the sites where food had once been placed. When food existed (on day 0), doves frequently visited the site for long periods. After the food was removed, the visiting times decreased gradually until there was no difference from the control site. The visiting time decreased immediately after food deprivation and leveled thereafter. However, this level was always higher than that in the control site. This shows that doves visit with high frequency the sites where food had been placed before, and spend some time there searching for food. In other words, doves remember sites where they once found food for a long time. Thus, if food is again supplied at those sites, they can easily find and consume it.

These results permit speculation about the food searching process of doves. They prefer to visit fields not covered with plants and search for food. If soybean seeds are planted there, they will return frequently to eat them. The rate of taking soybean seeds and cotyledons increases gradually; however, the number of cotyledons decrease rapidly due to the growth of plants. Thus, the birds must change to other foods, such as crop and weed seeds. When the wheat or barley harvest begins, it supplies them with a large amount of seeds which drop to the ground during harvesting. As a result, the dove damage to soybeans decreases rapidly, as seen in Figure 1A. The areas of such alternate fields and the crop amounts are larger than those of soybeans. Therefore, we can conclude that the intensity of damage to soybeans depends upon the amount of soybeans relative to the other foods available to doves.

These results suggest a practical method for avoiding the damage by doves: the sowing of soybean seeds in fields after the harvest of the wheat or barley. At that time the large amounts of food available to doves decreases the relative importance of

soybeans as a food source. Greater results can be expected when applying control methods in these situations.

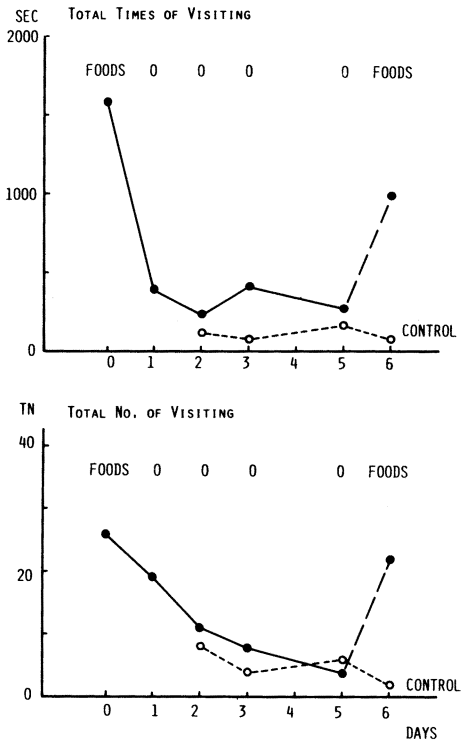

FIGURE 3. Total visiting times of doves and the total number of visits to a site where food had once existed and to the "control site" where no food existed.

Figure 4 shows the cumulative percentage of plants damaged by doves when the seeds were treated by two kinds of repellents. These experiments were repeated twice. In the first experiment, conducted at the beginning of May, the plants suffered the most damage (see Fig. 1A). The percentage of plants damaged in the control increased at the highest rate, so there was a difference in the damaged plants between the control and two repellents from the fifth to ninth days. Thus, doves preferred to eat untreated plants to those treated with repellents. However, the effect of repellents is not complete; the attack rate on treated plants continued to increase, finally attaining 100%.

The second experiment was conducted in mid-May when the damage to soybeans began to decrease (Fig. 1A). The difference in the doves' preference intensified, and 30% of treated plants remained intact. We can expect from these results greater effect from repellents if they are applied at times when damage levels are decreasing. These results lead us to conclude that the effect of bird control methods or devices largely depend upon the relative amounts of susceptible foods available.

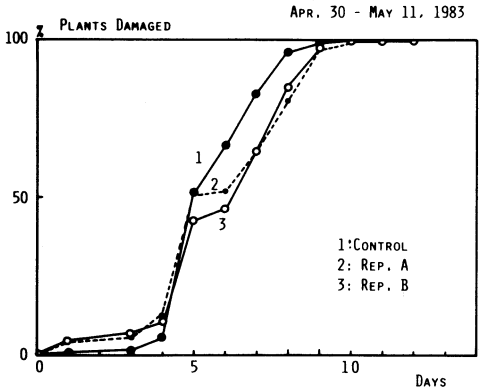

FIGURE 4. Cumulative percentage of soybean plants damaged by doves when seeds were treated or not treated by repellents. This experiment was conducted during the time of the severest damage.

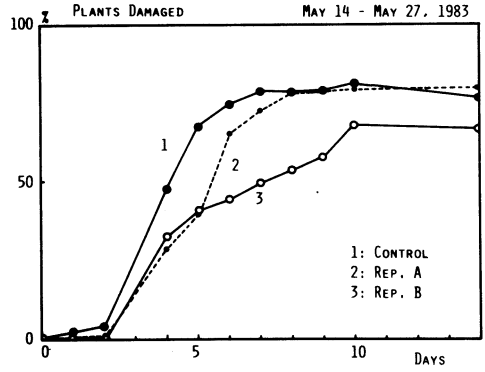

FIGURE 5. Cumulative percentage plants damaged by doves when seeds were treated by the same repellents as those in Figure 4. This experiment was conducted during the time when the damage began to decrease.

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