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THE DISCRIMINATION OF MALVAVISCUS ARBOREUS FLOWERS BY THE SUNBIRD, NECTARINIA OSEA

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SUMMARY

Nectarinia osea (Nectariniidae) is a bird that bores holes into mature *Malvaviscus* flowers. Experiments with cut-off styles from flowers, and grafting of styles onto buds, show that the protruding style is the effective stimulus for sunbirds to bore holes in the *Malvaviscus* flowers.

1. INTRODUCTION

Nectarinia osea (Nectariniidae) is a minute sunbird of about 5 grams, which belongs to the Passeriformis. This group is most prevalent in the tropics and sub-tropical regions of the old world. Members of the group are nourished mainly by flower nectar and complete their diet with insects.

Nectarinia osea was first recorded in Israel at the end of the 19th Century and was described at that time as endemic to the lower Jordan Valley and to Mount Carmel (TRISTRAM 1884).

Since the beginning of the 20th Century. *N. osea* has expanded its distribution, mainly because of the exotic flowers newly introduced to Israel (NAHARI 1980). One of the favourite plants of this bird is the *Malvaviscus arboreus* which was introduced to Israel probably from South America.

Malvaviscus arboreus has flowers which are specialized for hummingbirds and was investigated by GOTTSBERGER (1971) in Brazil. It was observed that hummingbirds from the São Paulo region, with short bills, obtain the nectar by puncturing the corolla from outside. When nectar production starts, the stigma grows out of the flower tube and becomes visible to the birds. However, the visible stigma has no meaning for flower selection by the hummingbirds; Gottsberger came to the conclusion that the colour difference in the petals of nectar producing flowers and non-nectar producing flowers is the crucial method for discrimination by hummingbirds. *Malvaviscus* flowers are pendulous and closed, and are not pollinated in Israel. However, *Nectarinia osea* collect nectar from these flowers by piercing into the nectar chamber from the outside (GALIL 1961).

The aim of this study is to describe the way in which sunbirds in Israel choose the right flower compared with the way it is done in Brazil.

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2. MATERIALS AND METHODS

Flowers were examined in Ein-Gedi, a nature protection reserve near the Dead Sea, to which the sunbirds are native.

The flowers were tagged with paper tags and bagged with fine organdie mesh cloth. Later on, the flowers were collected in plastic bags.

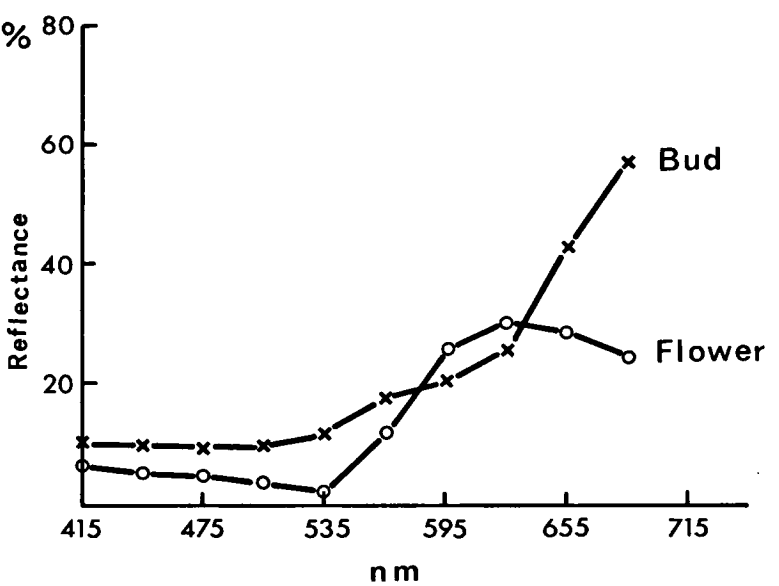
The reflectance of light within a wavelength range from 415 to 600 nm from fresh flower petals was measured with a 'Bausch & Lomb' spectrophotometer (Spectronic 20) with colour analyser reflectance attachment. Two subsequent stages were investigated: young flowers without nectar and with hidden stigma (bud), and mature flowers producing nectar with protruding stigma (flower).

3. OBSERVATIONS

Field observations showed clearly that in all cases where the stigma was prominent outside the flowers, these flowers contained nectar. Those flowers which still had a shorter style were empty (see also GOTTSBERGER 1971). The light reflectance of petals of the two subsequent stages of *Malvaviscus arboreus* is shown in *fig. 1.*

4. EXPERIMENTS AND RESULTS

Experiment 1: On the eve of the experiment, when the sunbirds were inactive, all the old flowers were removed and the remaining buds were tagged and bagged.



Two days later the flowers were exposed for the sunbirds to visit and later on all the flowers removed for examination in the laboratory.

The role of mature flowers with prominent stigma (A) and buds with hidden stigma (B) were compared (*table 1*).

Table 1. Percentage of punctured and intact flowers and buds

	Experiment 1		Experiment 3	
	A: Flower	B: Bud	A: Flower	B: Bud
Punctured flowers	96.3%	8.45%	72.4%	8.5%
Intact flowers	3.68%	91.5%	27.5%	91.4%
Total no. of flowers examined	190	142	58	70

The results show that there is a clear-cut preference to those flowers with the long and prominent stigma.

Experiment 2: The aim of this experiment was to pinpoint the role of the prominent stigma in mature flowers compared to buds. We carried out the experiment as in experiment 1, with A and B flowers, plus mature flowers with the style cut off (C), and buds with style grafted on (D) (*table 2*).

Table 2.

	Flower type			
	A Flower intact	B Bud intact	C Flower excised stigma	D Grafted bud
Punctured flowers	77.5%	10.0%	8.2%	75%
Non-punctured	22.5%	90.0%	91.8%	25%
Total no. of flowers examined	40	40	39	40

Experiment 3: One day after experiment 2 had ended, we again conducted a further experiment in the same manner as experiment 1, in order to see the influence of experiment 2 on the behaviour of the sunbirds (*table 1*).

It is clear that flowers with hidden style do not attract birds for the purpose of boring, but the 'hesitation' of the birds on mature flowers was greater.

DISCUSSION

Nectarinia osea can discriminate between flowers and buds. There is a correlation between nectar secretion and the style length and the light reflectance of the petals, but results of *table 2* show clearly that grafting a style onto an empty

bud can alter the attitude of the bird towards its target. Even mature flowers which reflect the 'right' colour do not attract the bird without the protruding style.

The conclusion we came to was that the difference in light reflectance is not crucial in order that the sunbird should choose the correct flower. The visible style might be the effective stimulus (TINBERGEN 1951).

All our observations (*tables 1, 2*) show that the bird bores about 10% of inappropriate flowers although it already 'knows' which ones are the 'correct' flowers. This 10% is the option that the bird keeps for new interpretation (BENE 1945; COLIAS & COLIAS 1968).

Bearing in mind that *N. osea* is a very small bird which has a relatively high metabolic rate (LASIEWSKI & DAWSON 1967), we believe that this method of scanning all the flowers available enables it to adapt rapidly to any change of environment, whether it be a result of migration or by seasonal changes in flora.

Since *Malvaviscus* is a plant not native to Israel, and did not evolve as a result of co-evolution with the local sunbirds, it is possible that one of the 'transmitters' which is conceived in its native country is not accepted here in Israel by *N. osea*, but these birds, which have an exceptional ability of association (NAHARI 1980) could recognize that the prominent stigma was a sign of the presence of nectar, a connection which could be exploited for its own benefit.

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