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THE INFLUENCE OF THE WIND ON NECTAR SECRETION FROM THE MELON AND ON THE FLIGHT OF BEES : THE USE OF AN ARTIFICIAL WIND-BREAK

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SUMMARY

Experiments were carried out in a two-year period of observation on an area near the coast of Tuscany (Italy) where there has been a considerable increase in melon cultivation. Where the presence of high winds is particularly important a polypropylene wind-break, which was easy to set-up, was used. The results show that the polypropylene wind-break offered suitable protection for honey bees engaged in pollination. The wind-break protected the flight of the insects and also the nectar secretion up to a distance equal to about 9 times its height.

INTRODUCTION

The melon is a *Cucumis* species of the family Cucurbitaceae, and its flowers may either be monoecious (European varieties) or hermaphroditic and andro-monoecious (American varieties).

There has recently been a considerable increase in melon production in Italy, in spite of the fact that the area under cultivation has diminished compared with the past. This has been possible thanks to new cultivation techniques, to the selection of varieties corresponding to the pedoclimatic characteristics of the individual cultivation areas, and to an increasing use of honey bees during the period of flowering. In the part of Tuscany near the coast, this cultivation has been continually developing over a period of years, to reach a high level of production which is practically all exported.

It is a well-known fact that this cultivation attracts pronubial insects, and in particular honey bees. This is mainly due to the fairly large quantity of floral nectar which contains quite a high concentration of sugar. The pollination activity of pronubial insects is essential for melon production. The sexual life of each

flower is short and the pollen is particularly heavy and sticky, and thus cannot easily be carried by the wind (MACGREGOR, 1965 ; PINZAUTI, 1981).

In certain meteorological conditions, the south-west wind may blow very hard on the coast of Tuscany during the period of flowering, thus preventing the pronubial activity of insects.

The aims of the present experiments were to assess the importance of the introduction of an artificial wind-break, to verify differences in the frequency of honey bees' visits and to determine the quantity of nectar secreted with or without the protective effects of the artificial wind-break.

MATERIALS AND METHODS

The observations were carried out in 1983 at the Torretta University Experimental Center (Tombolo Estate-Pisa) and in 1984 at the Rigoli Agricultural Far (Pisa).

The Torretta Center is about 3-4 km from the Tyrrhenian coast where the frequent presence of high winds is particularly important. The strongest wind which occurs during the period of melon anthesis is the south-west wind, which blows at an average of about 50 km.p.h. and gusts up to 80 km.p.h. The Rigoli Agricultural Farm is about 20 km from the sea and is influenced not only by the south-west wind but also by the wind from the north.

The wind-break used in the present experiments was composed of a closely-woven polypropylene net two meters high and twenty meters long.

The wind-break was placed in the middle of the field at the onset of flowering and was maintained upright for the entire flowering period of the varieties of melon examined (Fig. 1).

Observations were made to assess the following factors :

— wind strength (with and without the protective effects of the wind-break) ; this was carried out at a height of 0,4 meters by using a portable anemometer produced by the firm S.I.A.P. of Bologna-Italy ;

— oscillation of the melon flowers ; cards were placed at various fixed distances around the oscillating flowers and moved, were necessary, to determine the degree of oscillation ; the petals were marked with a fluorescent dust that is commonly used to mark honey bees and flowers (STOCKHOUSE, 1976 ; MACCHIA and PINZAUTI, 1985 ; PINZAUTI, 1985) ; measurements were taken at different distances from the artificial wind-break ;

— the frequency of bees' visits to flowers on plants protected by the wind-break and those outside the protection area ; observations were carried out on days of differing wind intensity, for periods of 30 minutes per plant between 9.00 a.m. and 5.00 p.m. ;

— the quantity of nectar secreted per day. These observations were carried out by using a micropipette, on 100 flowers for each variety examined : 50 were outside the wind-break protection area, and 50 inside. In each group, 25 were isolated with gauze, and the other 25 were isolated together with the mother plant by means of cylinders covered with 2 mm-mesh nylon netting, so as to create less wind resistance (the flowers belonging to the Supermarket, Chaca, Pancha and Burpee melon hybrids were situated in equal 4th order ramification positions) ;

— sugar concentration of the nectar extracted ; this was measured by taking several refractometric readings (using a Galileo refractometer, Abbe-model), percentage (w/w).

A nucleus of *Apis mellifica* on 5 honeycombs was placed in the wind-break protection area (see fig. 1).

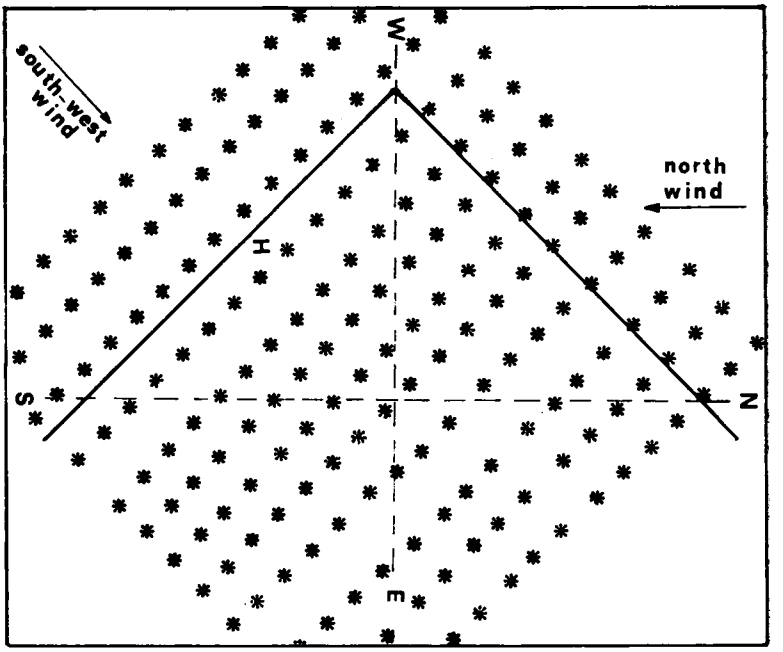

FIG. 1. — *Position and direction of each wind-break, and places were anemometric measurements were taken* (H = honey bee nucleus)

RESULTS AND DISCUSSION

Data referring to the decrease in wind speed obtained with the artificial wind-break are shown in fig. 2. These results are based on repeated anemometric observations carried out during intense blasts of wind that took place in the melon flowering periods of the years under examination. It can be seen that the percentage reduction in wind speed decreased in proportion to the distance from the wind-break at which measurements were made. The reduction in wind speed was evident up to a maximum of 16-18 meters from the wind-break (equal to about 9 times the height of the wind-break). In addition to this, there was turbulence, with speeds that were even higher that those found on the windward side. In a similar experiment carried out by GUYOT and DE PERCEVAUX (1965) the area found to be protected by the wind-break was slightly larger (about 10 times the height of the wind-break). This difference is very probably due to the different height at which measurements were taken.

The action of the plastic wind-break was also found to influence the pronubial activity of honey bees on melon flowers in periods of strong south-westerly gales. This can be clearly seen in Fig. 3 : even in the presence of winds blowing at more than 4 meters per second, the nucleus of honey bees on 5 honeycombs was found

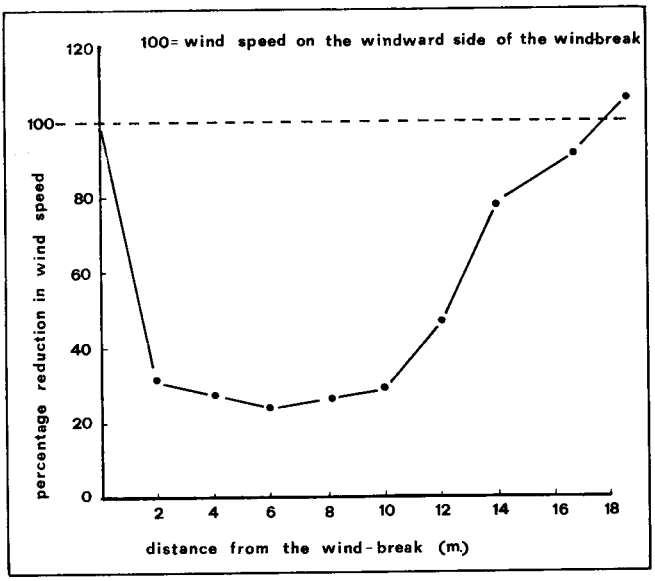

FIG. 2. — *Reduction in wind speed at different distances from the artificial wind-break*

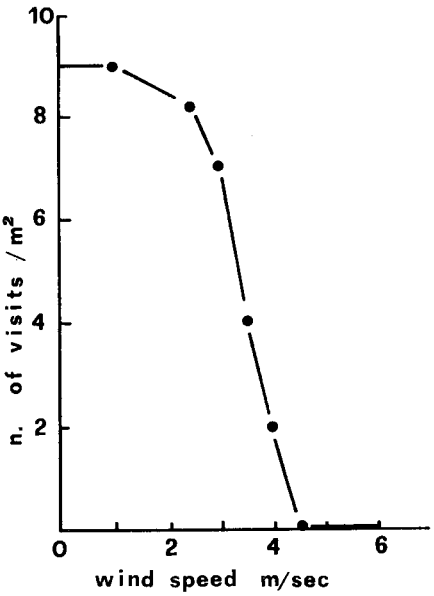

FIG. 3. — *Number of visits of bees to melon flowers correlated with the strength of the wind*

to be active. Only at a distance of about 14 meters from the wind-break was there first a reduction and then a total suspension of all gathering activity. Colonies of honey bees introduced in an area protected by a wind-break will guarantee adequate pollination, even in the presence of high winds, which are known to discourage the visits of pronubial insects (LEWIS and SMITH, 1969 ; DHALIWAL and ATWAL, 1976 ; SMITH and LEWIS, 1972 ; SMITH, 1976).

A large part of the discouragement may be attributed to the oscillation of the flowers caused by the strength of the wind (see Fig. 4), thus making it difficult for the honey bees to land on them. The negative influence of the wind on nectar

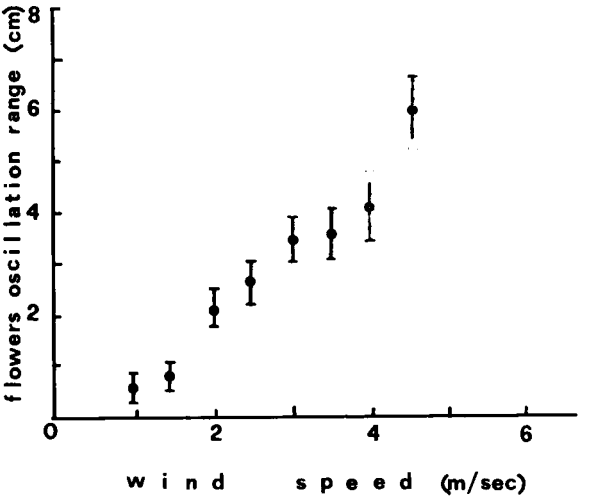

FIG. 4. — *Oscillation range of single melon flowers correlated with the strength of the wind*

secretion also contributed to the honey bees' behavior : nectar secretion was found to vary, though not in a statistically significant manner (Tab. 1), depending on the distance from the wind-break at which measurements were taken. Furthermore, the wind and the temperature were found to influence the sugar concentration of the nectar, which increased sharply as a result of evaporation, especially in the hotter hours of the day (see Fig. 5). Small differences in nectar secretion were found between gauze-covered flowers and nylon-mesh-isolated flowers. In the wind-break-protected area, the mean difference was about 0.1 mg/10 flowers/day, while outside this area it was about 0.3 mg/10 flowers/day.

TABL. 1. — *Daily mean total quantity of nectar gathered by micro-pipette (one time per day = 11.00 a.m.) from 10 female flowers on different days, without and with protection of the wind, and at different distances from the wind-break*

Melon hybrid (F_1) flowers	Quantity of nectar secreted (daily mean in mg) in melon's female flowers									
	without wind	with wind								
		without the wind-break	with the protective effect of the wind-break. Distance (m)							
			2 m	4 m	6 m	8 m	10 m	12 m	14 m	16 m
Supermarket	16.8	14.6	15.2	15.2	15.2	15.2	15.0	14.6	14.4	14.4
Chaca	14.8	13.8	14.4	14.2	14.2	14.2	14.0	13.8	13.8	13.6
Pancha	14.0	13.2	13.8	13.8	13.6	13.6	13.4	13.2	13.0	13.0
Burpee	15.4	14.0	15.0	15.0	15.0	14.8	14.6	14.4	14.2	14.0

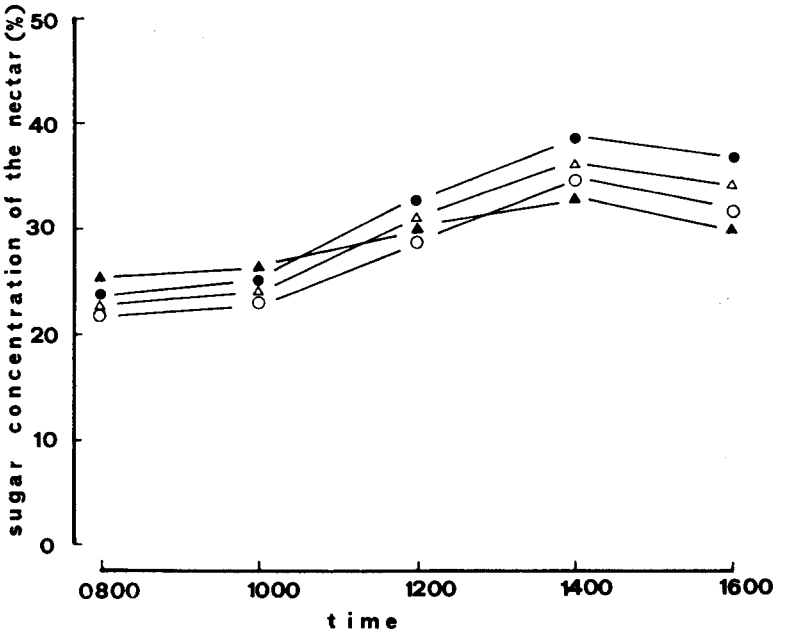

FIG. 5. — *Daily mean nectar sugar concentration from female flowers of melon* (hybrid F_1 : ● = Supermarchet ; ○ = Chaca ; ▲ = Pancha ; △ = Burpee)

CONCLUSION

The following conclusions may be drawn from an examination of the results obtained :

— Artificial wind-breaks can easily be set up in areas where entomogamous cultivations are frequently swept by high winds. Their use makes it possible for pronubial insects to carry out their pollinating activity over areas that are correlated to the length, and especially to the height of the wind-break itself, whose effects are felt up to distances about 9 times the height of the wind-break.

— In the case of particular cultivations such as the melon, where the period during which fertilization of individual flowers is extremely limited, the introduction of colonies of honey bees in wind-break-protected areas guarantees a normal pronubial activity even in the presence of high winds.

— Artificial wind-breaks also act as regulators of the water supply of plants (GUYOT and DE PERCEVAUX, 1965), and in the present experiment influenced, albeit not significantly, the volume of nectar secreted. They also have a stabilizing effect on the percentage of sugar present in nectar. Outside the protected area, the total

volume of nectar was lower, due to a higher level of evaporation, with a consequently higher sugar concentration.

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ZUSAMMENFASSUNG

DER EINFLUß DES WINDES AUF DIE NEKTARSEKRETION DER MELONE. VERWENDUNG EINES KÜNSTLICHEN WINDSCHUTZES

Infolge einiger Besonderheiten der Blütenbiologie der Pflanze (monözische, hermaphrodite oder andromonözische Blüten, besonders kurze Befruchtungszeit der Blüten sowie spezielle Eigenschaften des Pollens) wird die Bestäubung der Melone ausschließlich von blütenbesuchenden Insekten durchgeführt. Es wurde festegestellt, daß in dem untersuchten Gebiet die Honigbienen dabei eine herausragende Rolle spielen (86 %).

Die Versuche wurden in zwei Beobachtungsjahren in einem Gebiet nahe der Küste der Toskana durchgeführt, wo der Melonenanbau eine beträchtliche Ausweitung erfahren hat. Ein leicht aufstellbarer Windschutz bestand aus Polypropylen (Abb. 1). Es wurde die Nektarsekretion von vier Varietäten (F_1) der Melone zusammen mit der Zahl der Blütenbesuche durch Honigbienen bestimmt. Die Windgeschwindigkeiten sowohl in windgeschützten wie in ungeschützten Lagen wurden dazu in Beziehung gesetzt.

Die Ergebnisse zeigen, daß der benutzte Polypropylen-Windschutz einen geeigneten Schutz für die zur Bestäubung eingesetzten Bienenvölker bot und daß sowohl der Flug der Insekten (Abb. 2) wie die Nektarsekretion (Tab. 1) bis zu einer Entfernung von der neunfachen Höhe des Windschutzes gesteigert wurden (Abb. 3). Der künstliche Windschutz hatte auch einen stabilisierenden Einfluß auf die Zuckerkonzentration im Nektar (Abb. 5).

RÉSUMÉ

L'INFLUENCE DU VENT SUR LA SECRÉTION NECTARIFÈRE DU MELON ET SUR LE VOL DES ABEILLES. EMPLOI D'UN BRISE-VENT ARTIFICIEL

En raison d'une série de problèmes liés à la biologie florale (fleurs monoïques, hermaphrodites ou andromonoïques, l'extrême briéveté de l'anthèse et les caractéristiques particulières de son pollen), la pollinisation du melon est effectuée exclusivement par les insectes pollinisateurs parmi lesquels, dans la région considérée, les abeilles domestiques se sont avérées fort nombreuses (86 %).

L'expérimentation a été menée sur 2 ans dans une région proche de la côte toscane (Italie), où la culture du melon s'est considérablement développée. Un brise-vent en polypropylène (Fig. 1), facile à installer, a été utilisé. On a évalué la secrétion nectarifère de 4 variétés F_1 de melon, ainsi que le nombre de visites par les abeilles sur les fleurs, en relation avec l'intensité du vent à la fois dans la zone protégée par le brise-vent et dans celle non protégée.

Les résultats montrent que le brise-vent en polypropylène utilisé a fourni une protection convenable aux colonies d'abeilles impliquées dans le travail de pollinisation et qu'il a protégé le vol des insectes (Fig. 2) et la secrétion nectarifère (Tabl. 1) jusqu'à une distance égale à 9 fois la hauteur du brise-vent (Fig. 3). Le brise-vent artificiel a eu également un effet stabilisateur sur la concentration en sucre du nectar (Fig. 5).

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