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Peculiarities of Pollination of Genetic Resources of Vegetable Crops

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ABSTRACT

In order to achieve high yields from melons crops, regular insect pollination of their blooms is required. The morphobiological characteristics of the melon, cucumber, watermelon, and pumpkin flowers varieties studied (cup-shaped, large intensely colored corolla with various spots, strokes, stripes on the petals, release of a large amount of nectar, openness during flowering) attest to insect pollination adaptability. Bees (Anthophila), bumblebees (Bombus), ants (Formicidae), and diurnal butterflies pollinate melon, watermelon, and pumpkins (Lepidoptera). Pollen grains with pores on the exine are big, which causes them to gather together, stick to insects, and make it nearly hard for pollen to be delivered by wind. The papers also include pumpkin crop attractants and pollination methods.

Keywords: *xenogamous, gaitenogamous, autogamous, melittophilia, mermecophilia, my philia, psych philia, nectar.*

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INTRODUCTION

Gourds (watermelon, melon, pumpkin, and other members of the pumpkin family) have a root system that consists of a main root and lateral roots of the first order, as well as a mass of thin branches of the second, third, and further orders, as well as root hairs. It's well-developed, however it's mostly found in the top soil strata [5, 6, 7].

Gourd roots can be found at a depth of 20–30 cm. During the growing season, especially in Uzbekistan, this layer dries off. Drip irrigation has been used in melon farms in recent years. First and foremost, with this method of irrigation, you must choose a soil moisture contour that will deliver moisture to the crop's root system. It is determined by the granulometric composition of the soil and the intensity of one dropper per unit of time water delivery. The broader the wetness zone is in relation to the row's center axis, the higher the water flow. With drip irrigation, increasing the irrigation time does not expand the moisture contour over the field surface because gravitational forces only increase the depth of soil wetting, which is unacceptable for gourds because actively growing roots with root hairs that feed the plant are located shallow [5, 6, 25].

Entomophily is a characteristic of the Cucurbitaceae [14, 19, 20, 23, 27, 28]. Pollinating agents are used to carry out xenogamous, heitenogamous, and autogamous pollination in melon, cucumber, watermelon, and pumpkin, according to [1, 15]. S.K. Tsygankov (1948) and A.N. Nevkryta (1953) demonstrated that in order to get high yields from gourds, regular insect pollination of their blooms is required. Additional pollination

[2] in Uzbekistan's rainfed circumstances dramatically reduced the number of unattractive fruits in the watermelon Kuzybai rainfed (from 25.5 to 2.4 percent) while greatly increasing the yield of marketable fruits (from 50 to 60 c/ha).

The flowers of the melon, cucumber, watermelon, and pumpkin kinds tested (cup-shaped, huge strongly colored corolla with varied spots, strokes, stripes on the petals, release of a considerable amount of nectar, openness during flowering) attest to their adaptability to insect pollination. Pollen grains with pores on the exine have a high size, which causes them to consolidate into lumps, attach to insects, and make pollen transport by wind nearly difficult.

MATERIAL AND METHODS

The objects of research are Uzbek representatives of the gourd family, belonging to 4 genera: *Melo Adans., Cucumis L., Citrullus Schrad., Cucucrbita L*.

1. *Melo ameri* Pang. variety: Kokcha 588, Kichkintay, Kok Tinni 1087, *Melo zard* Pang variety Koi-bash 476.
2. *Cucumis sativus* L. variety: Uzbek 740, Margilan.
3. *Citrullus vulgaris Schrad*. variety: Shirin, Sharq ne'mati, Kozybai 30, Uzbek 452.
4. *Cucurbita maxima Duch*. variety Spain 73; *Cucurbita moschata* (Duch.) Poir. variety Palav-kadu 268.

The studies were carried out in 2019-2021. Field experiments were carried out at the agricultural site of the Tashkent State Agrarian University in 2019-2021. Laboratory studies were carried out at the Department of Horticulture and Viticulture, Tashkent State Agrarian University, as well as in the laboratory of microbial enzymes of the Institute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan. Production trials were carried out on the same farms as the sowing trials.

The plain zone of Uzbekistan is characterized by an abundance of heat and light. The climate here is sharply continental. It is characterized by large amplitudes both in the daily and in the annual course of air temperatures with a pronounced periodicity of atmospheric precipitation and their confinement to the winter-spring season.

Research work, field experiments, and laboratory studies were carried out according to the following generally accepted classical methods, guidelines, recommendations and instructions. Methods of field experience (Dospekhov B.I., M., 1985); Methods of physiological research in vegetable growing and melon growing (under the editorship of V.F. Belik, 1970); Guidelines for the determination of nitrates in crop production (M., 1986).

Equipment for drip irrigation in experiments is on 2 hectares area. Drip irrigation technology is used for melon (1 ha) and watermelon (1 ha).

Phenological observations were carried out every 5 days in 5 replications for each species in varieties, from emergence to the end of the growing season. The growth and development of vegetative and generative organs were monitored. The number of male, female, and hermaphrodite flowers on each plant was counted during the entire growing season.

Observations on the biology of flowering were carried out on 10 selected and labeled plants of each variety from 06:00 to 22:00. Flowering for pollination was carried out according to the method proposed by A.N. Ponomarev (1960). We studied the duration of flowering of a flower, plants, the order of blooming flowers, the daily flowering regime, the structure of flowers, their opening, the quality of pollen, types and methods of pollination.

The duration of the flowering of a flower was determined from the moment of its opening until the complete wilting of the corolla. To determine the duration of flowering, labeling was carried out starting from the day of opening of the first flower to the opening of the last one. To understand the seasonal dynamics of flowering, we used the method of registering inflorescences that bloom in the first place (the beginning of flowering plants), during the period of mass flowering (flowering of 70-90% of plants) and at the end of the growing season.

The daily rhythm of flowering plants was studied by the method of quantitative accounting of opening flowers every 2 hours. To avoid repeated counting of the same flowers, they were marked with ink when counting. At the same time, the temperature and relative air humidity (RH) were measured with an aspiration psychrometer.

The seasonal dynamics of flowering plants was observed on 5-10 marked plants every 3 days by taking into account the number of opened male, female and hermaphroditic flowers. Every 3 days, the length and width of developing ovaries were measured, and the dynamics of fruit growth was analyzed.

The data obtained were processed by the method of variation statistics (Rokitsky, 1967; Dospekhov, 1985).

The fulfillment of pollen was determined on temporary preparations by the acetocarmine method. On the same preparations, the diameter of fertile and sterile pollen grains was measured using an eyepiece

micrometer. Pollen was taken at the moment of flower opening (in the morning hours). Counting and measurements were carried out on 5 glasses in 10 fields of view of the microscope.
The preparation was studied under microscopes MBI-3, MBR-3, MV-1, MBS-8. To photograph the buds and flowers, as well as the details of the flower, an MFN-5 photo attachment was used on an MBS-2 stereoscopic microscope.
Small-plot experiments were carried out in quadruple repetition on four-track plots of 28-40 and length. Plot area 120-160 m^2 is depending on the option. Production verification of varieties and technology was carried out in two repetitions on an area of 0.5-1.0 ha.
To determine the field germination of seeds in each plot, 40 accounting nests were allocated, each of which was sown with 10 seeds. Subsequently, the number of seedlings in each nest was counted. The density of plant standing was determined on the actually considered area of each plot, the number of plants and the percentage of plants from the calculated number were counted. Then the average percentage was calculated by options.

RESULT AND DISCUSSION

Pollination is the hub of the spoked wheel of production, around the edges of which sit all the consumers—humans, livestock, and wildlife. The biodiversity of the world's dominant flora (flowering plants) and dominant fauna (insects) are so closely and evolutionarily intertwined through pollination that the erosion of the process will have serious ecological consequences. In fact, pollination is now considered to be an endangered ecosystem service that requires close attention in all terrestrial environments, from intensive agriculture to wildlife [26]. Moreover, non-pollinating flower visitors in the web of life bring benefits, but sometimes problems that are important to other aspects of ecosystem functioning.
Pollination is simply the transfer of pollen from the anther to the stigma of the pistil. After the reproductive structures of the plant have appeared, pollination is the next step in the reproduction process. Abiotic pollination occurs with the help of wind, water and gravity. Biotic pollination is produced by animals. There is an extensive specialized set of terms for pollination and plant breeding systems, but this review does not need to be analyzed in detail.
Anthophiles are animals that visit flowers. They visit flowers in search of pollen, nectar, oil, or flower tissue to meet their nutritional needs [32]. Pollinators are anthophiles that pollinate plants. Not all anthophiles are effective pollinators: some flower thieves may destroy resources that pollinators seek or eat pollen that is needed for abiotic pollination [33] other harmless anthophiles may simply rest on flowers and eat up resources that are left after pollination. Although pollinators are vital for plant reproduction, non-pollinating (or poorly pollinating) anthophiles can also be important for ecosystem function. For example, many insects that are useful in pest biocontrol require food produced by flowers for mating, host discovery, oviposition, and life cycle completion [34]. There are also anthophiles who use flowers as traps for their victims.
The results of studies of the pollination ecology of plants with morphologically different, but similarly pollinated flowers made it possible to classify the diversity of flowers according to the method of pollination and functional structure [14]. The most developed system [22] classifies flowers according to pollination methods, morphology and reflects the main levels of organization of the pollination process. The authors distinguish 3 large groups that differ in functional state at the time of pollination: 1st group - flowers opening during flowering; 2nd group - flowers closing during flowering; 3rd group - very large and, in turn, divided into 2 subgroups: 1) nondescript flowers; 2) flowers are attractive, catchy. The 2nd subgroup is divided into 6 types, differing in the position of the stamens and pistils in the flower.
Attractant male flowers of melon, cucumber, watermelon and pumpkin - pollen, female and bisexual - nectar
According to the classification of K. Fegri, L. Van der Peil (1982), all the pumpkin plants studied by us belong to the 1st group - flowers open during flowering; 2nd subgroup - flowers are attractive, catchy; 1st type is cup-shaped or saucer-shaped flowers (Table 1).
In the conditions of the Tashkent province, there are much more visits to melon flowers than in the rainfed crops of Uzbekistan. The main pollinators of melons are ants, bees, bugs, and butterflies. Almost all authors note that the main pollinators of melons, like other melons, are bees. According to our observations, melon flowers are especially intensively visited by ants, which appear first on them.
From 7 o'clock bees (Anthophila) visit mainly male flowers, from 9 o'clock - female and bisexual. After 10 a.m., a more intense flight of pollinators is usually observed. Most actively they visit flowers at 11-12 o'clock.
Insect visits to 1 bisexual and female flower are, on average, much more than 1 male. Apparently, but due to the size of bisexual and female flowers, their brighter yellow color.

A bee visits 8-9 flowers within 1 min. Each vini lasts about 7s, the collection of nectar from a flower is on average 14 mg, pollen - 2.2 mg. Bisexual flowers produce more nectar, but staminate flowers have a higher concentration of sugar in it, so bees visit them more readily (Malinina, 1994).

During the mass flowering of Melo ameri for 5 minutes per 10 m2 at 10–11 h, there are 16–18 pollinators, and Melozard plants (variety Koi – bash 476) visit 20–23 pollinators at 10–12 h (Fig. 1). The largest number of visits by insects - pollinators is observed at 10 - 12 hours at a temperature of 32 - 34°C and relative and humidity of 28-30%. At 16:00 at a temperature of 39–40°C and RHV of 14–15%, the flight of pollinators is sharply reduced. Insects visit and pollinate melon flowers from 6 a.m. to 7-8p.m.

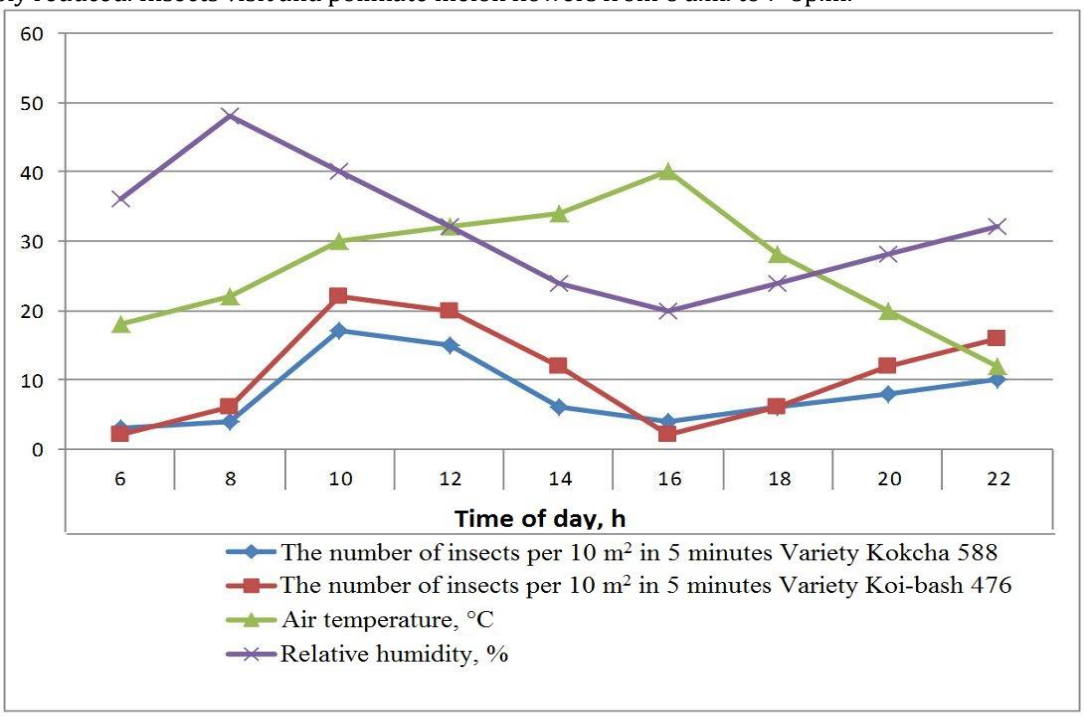

Fig 1. *Dynamics of insect attendance of melon flowers during the period of mass flowering. 1 - M. ameri, variety Kokcha 588; 2 – M zard, variety Koi-bash 476, 3 – air temperature °C, 4 – relative air humidity, %.*

The method of melon pollination depends on the composition of insects in given ecological and climatic conditions. At the same time, in many cases the same variety under the same conditions is self-pollinating, in others it is cross-pollinating.

When adverse conditions interfere with the flight of insects, the flowers are pollinated by crawling insects - ants and thrips.

In the phase of mass flowering of plants, on warm and sunny days, we studied the attendance of insects - pollinators of watermelon and pumpkin flowers in the Kashkadarya region (in Uzbekistan) (Fig. 2 and 3).

Insects - pollinators of melon flowers

	18.07.2019	20.07.2020	21.07.2021
Ants (*Formicidae)*	164	179	255
Flies (*Diptera)*	109	152	143
Bees (*Anthophila)*	121	164	90
Bedbugs (*Heteroptera)*	103	98	76
Butterflies (*Lepidoptera)*	65	59	30
Bumblebees (*Bombus)*	29	63	54
Thrips (*Thysanoptera)*	162	184	65
Beetles (*Coleoptera)*	46	58	24
Other insects (*Insécta)*	221	230	202

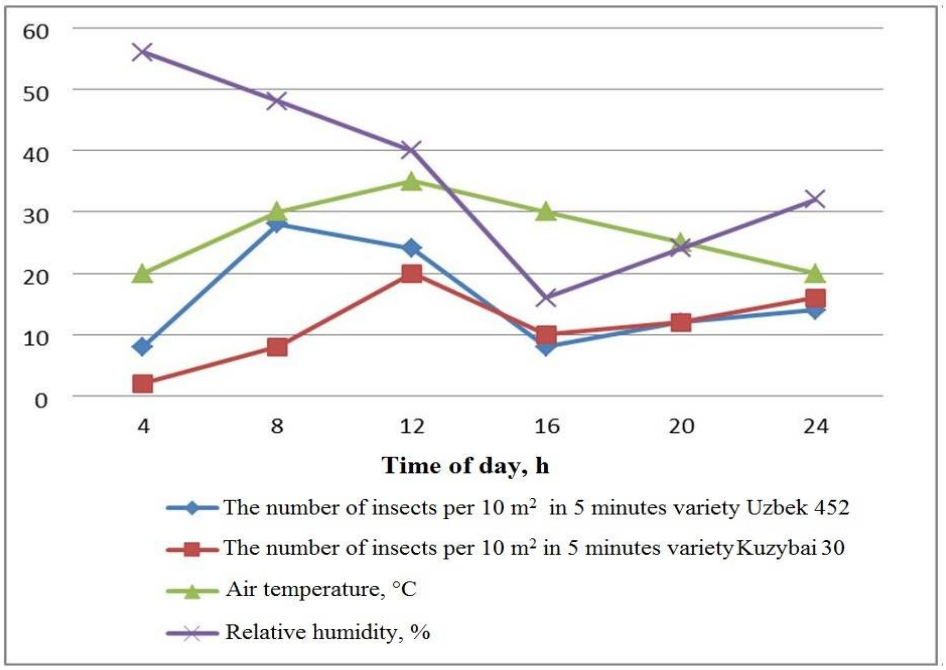

Fig 2. *Dynamics of attendance by insects of watermelon flowers Cutrillus Lanatus in the phase of mass flowering. 1 - variety Uzbek 452, 2 - variety Kuzybai 30, 3 - air temperature, °C, 4 - relative humidity humidity %.*

The dynamics of insect attendance of flowers of the watermelon varieties Uzbek 452 and Kuzybai 30, pumpkin Spanish 73 and Palav-kadu 268 is different. In watermelon crops, the flight of pollinators is observed from 6 to 20-21 hours. The peak of pollination occurs at 9-12 hours. At this time, at a temperature of 30 - 3°C and RH 38 - 40% for 5 minutes, plants of the Uzbek 452 variety per 10 m² are visited by 25 - 30 insects - pollinators, of the Kuzybai 30 - 16 - 18 variety.

In the daily rhythm of visits by insects to the flowers of the pumpkin Spanish 73 and Palav-kadu 268, the same regularity is observed. Unlike Cucurbita moschata, Cucurbita maxima plants are visited by insects evenly during daylight hours (2–4 specimens per 10 m² in 5 min). By 6 p.m. the air temperature drops to 28-29°C and there are a few more insects. At 8 p.m. at a temperature of 23-28°C and RH 12-16%, insects continue to visit the flowers, but their number is insignificant. After 8 p.m., their flight stops.

The issue of cross-pollination is very important for the restoration of local high-quality melon varieties. Many varieties are grown on the same farm. It would be necessary to know what distance should be between them, it is believed that different varieties behave differently in this respect. There is no reason to assume both mandatory hybridization and complete self-sterility of varieties.

However, [30] it is notes the tendency of melon varieties to mutual cross-pollination. According to many practitioners in Uzbekistan, even in the joint sowing of melons, they retain varietal purity.

We consider it necessary to conduct research to identify exclusively self-fertile varieties, as well as self-fertile varieties prone to mutual cross-pollination. This will change the seed production system and will affect breeding methods. Spatial isolation should be carried out depending on the individual characteristics of the variety, taking into account the structure of the flower.

Literature data on the issue of pollination of gourds are contradictory. N. I. Vavilov (1925) considers autogamy impossible; they admit the possibility of autogamous pollination of bisexual flowers. He writes about a high percentage of setting during geitenogamous pollination in watermelon. Varieties and forms of gourds with dioecious flowers are typical cross-pollinating, with bisexual flowers are facultative self-pollinating [9, 27]. According to data without outside interference, bisexual flowers in most cases remain unfertilized.

With artificial application of pollen on the stigma of your own flower, the setting reaches 80%. In connection with disagreements on the issue of self-pollination in gourds, we conducted experiments. In the first variant, bisexual melon flowers were isolated. Fruit set did not occur, although the pollen was quite fertile. In the second variant, isolated flowers, after opening, were pollinated with their own pollen and isolated again, (20-25% of the fruits were tied.

In the first variant, single pollen grains were observed on the stigmas of flowers, and fertilization did not occur. As noted, the amount of pollen necessary for fertilization and normal development of the fetus should correspond to the number of ovules.

Table 1.FEATURES OF POLLINATION IN MELONS

Type and grade			Pollination agents or methods	Attractants			The functionality of the state of the flower at the time of pollination (according to Fehry and Van der Piel)	pollination type
				Primary		Secondary		
	male flowers	Female and bisexual flowers		male flowers	Female and bisexual flowers			
Melo chandalak Kichkintoy Kok Tinny 1087 Obi-novvot	Biotic; etodynamic	Biotic, topocentric, invertebrates	Melittophilia, mermecophilia, rarely myophilia, psychophilia	Pollen	Nectar	Large and brightly colored flowers with various spots on the petals	All investigated pumpkins belong to the 1st group - flowers open during flowering; 2nd subgroup - attractive flowers, throws, type I - bowl-shaped or saucer-shaped flowers	Xenogamy, geitonogamy, forced autogamy
Melo ameri Ich-kyzyl large-fruited 1233 Kokcha 588 Shakar-palak white-haired	Biotic; etodynamic	Biotic, topocentric, invertebrates		Pollen	Nectar			
Melo zard Ala puchak Koi-bash 476	Biotic; etodynamic	Biotic, topocentric, invertebrates		Pollen	Nectar			
Melo agrestis Umyrvaks	Biotic; etodynamic	Biotic, topocentric, invertebrates		Pollen	Nectar			xenogamy, geitonogamy
Cucumis sativus Margilan 822 Uzbek 740	Biotic; etodynamic	Biotic, topocentric, invertebrates	melittophilia, myophilia,	Pollen	Nectar	Large and brightly colored flowers, especially female		
Citrullus lanatus Shirin Sharq ne'mati Uzbek 452 Kuzybai 30	Biotic; etodynamic	Biotic, topocentric, invertebrates	Melittophilia, myophilia, psychophilia	Pollen	Nectar	Large and brightly colored flowers with strokes and marks		Xenogamy, geitonogamy, contact and gravitational autogamy
Cucurbita maxima Spain 73	Biotic; etodynamic	Biotic, topocentric, invertebrates	Cantarophilia, myophilia	Pollen	Nectar		Larger ones with stripes and strokes that enhance the functions of attractants	xenogamy, geitonogamy
Cucurbita moschata Palav-kadu 268	Biotic; etodynamic	Biotic, topocentric, invertebrates	Milittophilia, Cantarophilia, Myophilia	Pollen	Nectar			Xenogamy, geitonogamy, contact, gravitational and ombro-autogamy
Bronia melonacarpa	Biotic, abiotic	Biotic, topocentric, invertebrates	Anemophilia, melittophilia	Pollen	Nectar		Relatively small, colored, with various spots	Xenogamy, geitonogamy possibly apomixis

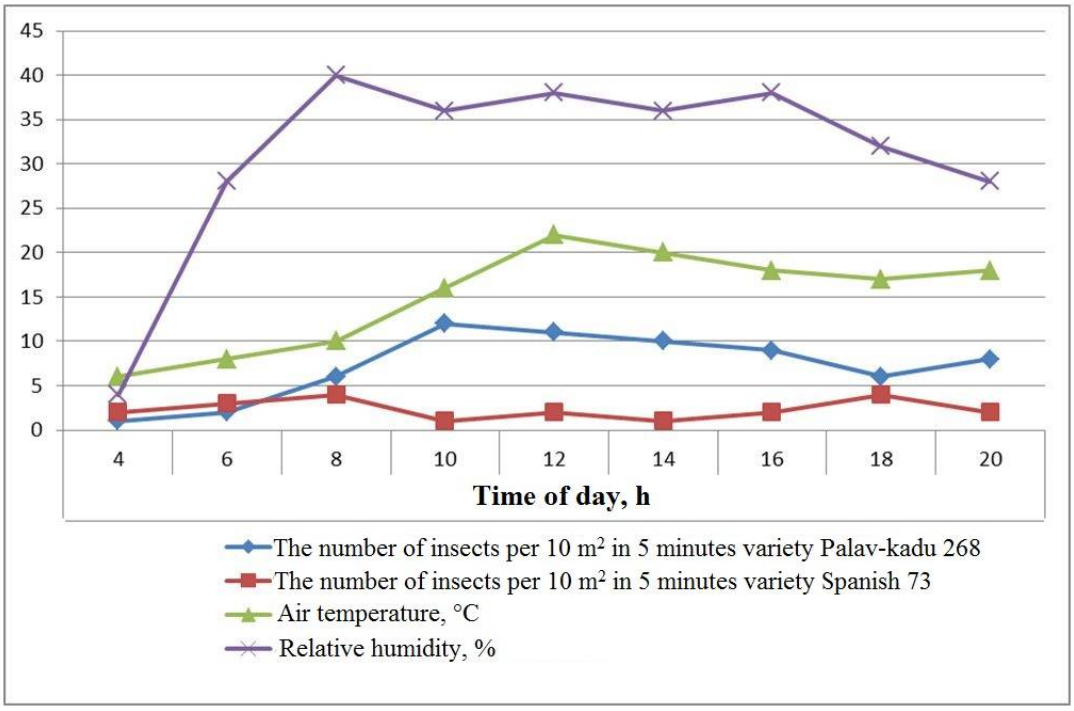

Fig.3. Dynamics of attendance by insects of Cucurbita L. flowers during Mass flowering. 1 - C. moschata, variety Palav-kadu 268, 2 - C. maxima, variety Spanish 73, 3-air temperature, °C, 4-relative air humidity, %

In the first version, there was no such correspondence. In the second variant, mass germination of pollen on the stigma was observed, which indicates the possibility of self-pollination in bisexual melon flowers. Under natural conditions, self-pollination is provided by insects.

Thus, without outside intervention, bisexual flowers remain unfertilized even in the presence of fertile pollen.

Melon is mainly pollinated by bees, wasps and bumblebees. According to the classification [26], this is melittophilia. According to the melon flowers, ants also visit intensively. Therefore, melon is characterized by pollination by ants (myrmecophilia). In addition, dipterous insects, including flies (mnophyly), as well as diurnal butterflies (psychophilia), participate in the pollination of melon flowers. Melon flowers, pollinated by diurnal butterflies, smell quite strongly, are usually brightly colored, and yellow and orange tones predominate in color.

Large and brightly colored cucumber flowers, especially female ones, are pollinated by bees, wasps, bumblebees (melittophilia) and two-rounded insects of I mnofilia).

Watermelon flowers are fragrant, brightly colored, dominated by yellow, orange, blue and blue tones. In watermelon, like in melon, melittophilia predominates. Along with bees, watermelon is pollinated by butterflies (diurnal), as well as wasps, bumblebees, etc. The number of visits by insects to fruit-forming and male flowers is the same. It is noted that on the rainfed watermelon flowers are visited by insects much less than in irrigated conditions. Apparently, the formation of many (25.5%) ugly fruits in rainfed crops is associated with this [2].

The nectaries in the male watermelon flowers are represented by an outgrowth of pistillodium, the base fused with the side walls and the perianth. On their surface is a small funnel-shaped notch. In female flowers, nectaries are in the form of a roller, tightly surrounding the style, fused with the perianth and bases of staminodes [28]. Watermelon flowers have large reserves of nectar (up to 10 kg/ha) containing up to 22% sugar [29].

Bees visit pumpkin flowers for nectar and pollen. One bee can carry up to 70 thousand pollen grains, while an ant - only 360 grains, tripe - 6. To obtain a full-fledged harvest of watermelon fruits, the frequency of visits to a female flower by bees should be approximately equal to 36, male - 20 [14].

Pollination of pumpkin flowers is largely determined by the amount of nectar in the nectaries located at the base of the stamens and pistil. In female flowers, nectar is 2.5 - 6.0 times more. According to Zirn, 1 flower of Cucurbita maxima produces 130 mg of nectar, plant I - 65 g, or 164 - 230 kg/ha, with a sugar content of 35 - 40%; (moschata - respectively 9.5 mg and 28 g (60 - 84 kg/ha) with a sugar content of 26 - 30%; C. rero - 42 mg and 20 g (90 - 102 kg/ha) with a sugar content of 23 - 48%.

The main pollinators of pumpkins are bees. They visit male, female and bisexual flowers equally. According to [14], pumpkin is pollinated by bees by 94.7%. A bee spends an average of 20 minutes in a flower, and 10 minutes in flight. For complete pollination of the first female flower, 20 visits by bees are required, and the bees transfer pollen to it from an average of 40 male flowers. Recommend additional pollination of pumpkin flowers and in the presence of pollinators, as this increases the yield by 50 - 72%.

The pumpkin varieties studied by us are pollinated mainly by bees, as well as wasps, bumblebees and beetles (cantharophilia). Flowers and flowers are usually much larger than those of melon, watermelon and cucumber, but they are lighter, with dense parts of the perianth, attractants are easily accessible in them. Beetles use pollen, food bodies, oils in flowers.

Insects, including Diptera, begin to visit pumpkin flowers at 07:00. At 08:00, their maximum number is noted. By 8 p.m. Pollination stops. In Cucurbita maxima, variety Spanish 73, cantarophilia and myophilia are most common, in C. moschata, variety Palav - kadu 268 - also melittophilia.

R. Ya Levina (1981), K. Fegri, Van der Pael (1982) in many angiosperms, [12, 28] in gourds, a combination of 3 types of pollination is noted - xenogamy, heitenogamy and autogamy, which is typical for the objects we studied. In all cases, pollination is biotic.

The progressivity of biotic pollination compared to abiotic one is that it stimulates the development of both components: the structure of a flower or inflorescence is improved depending on the agent that produces pollination and the behavior and body structure of the pollinator itself changes [26]. The behavior of pollinators in a flower is different. Allocate topocentric and this dynamic pollination.

In functionally and truly male flowers Melo chandalak (variety Kichkintoy, Kok Tinni 1087 and Obi - novvot), M.ameri (variety Ichkyzyl large-fruited 1233, Kokcha 588 and Shakarpalak white-fleshed 554), M zard (variety Ala - puchak, Koi - bash 476 , Umyrvaki 3748), Citrullus lanatus subsp. vulgaris (variety Shirin, Sharq ne'mati), Cucurbita moschata (cultivar Palav-kadu 268), in male flowers Melo agrestis (wild weed-field melon), Cucumis sativus (variety Uzbek 740 and Margilan 822), Cucurbita maxima (variety Spanish 73) and Bryonia melanocarpa are insect pollinators actively reaching mature (opened) anthers and carrying pollen on the stigma of another flower's pistil. This type of pollination is called biotic topocentric.

In functionally and truly female flowers of Melo chandalak, M. ameri, M. zard, Citrullus lanatus subsp. vulgaris and Cucurbita moschata, and female flowers of Cucumis sativus, Cucurbita maxima, Bryonia melanocarpa, Melo agrestis, as well as bisexual flowers, due to their structural features, pollinators move so that they come into contact with the stigma - in female flowers, with stamens and stigma - in bisexual. The result is biotic and dynamic pollination.

M. I. Malinina (1994) after drew attention to heterostyly in melons. In her bisexual flowers, the position of the column in relation to the stamens can be different: the stigma of the pistil above the upper edge of the stamens is long-columnar flowers; stamens at the level of the stigma are equal-columnar; the stigma and pistil below the upper edge of the stamens, which tightly cover the stigma, are short-columnar flowers. The heterostyly in melon is more pronounced than in watermelon. M. I. Malinina (1994) established 2 types of flowering in bisexual melon flowers: 1) with a closed stigma in short-columnar flowers, when the stamens cover the pistil, 2) with an open stigma in long-columnar ones, when the stamens are below the stigma or at the same level, not closing it. Out of 544 specimens studied by us, 34 I (63%) turned out to have a closed stigma. Varieties with short-columnar flowers originate mainly from the USA, Japan, Australia and Bulgaria. Samples from Turkey, Afghanistan, Russia have predominantly long-columnar flowers. The representatives of the genus Melo studied by us are characterized by short-columnar flowers. According to the classification [14], this is a flowering type with a closed stigma.

The phenomenon of heterostyly has been noted in many species and genera of angiosperms. Observations have shown that, according to the type of flowering, variety samples can be divided into 3 groups: 1) varieties with short-columnar flowers, prone mainly to self-pollination; 2) varieties with equal-columnar flowers, prone to both self-pollination and cross-pollination; 3) varieties with pistillate and long-columnar flowers, prone to cross-pollination.

Based on our research [1], we can conclude that cultivated species of melon Melo chandalak, M.ameri and M.zard are characterized by xenogamy, geitonogamy and forced autogamy, for wild weed-field melon M.agrestis xenogamy and geitonogamy; for cucumber Cucumis sativus, varieties Uzbeksky 740 and Margilansky 822 - geitonogamy and xenogamy; length of watermelon Citrullus lanalus subsp. vulgaris, variety Shirin - Xenogamy, geitonogamy. In some cases it's bisexual flowers. There is a rash of pollen and it's settling on the stigma under the influence of its own gravity - gravitational autogamy. Watermelon Sharq ne'mati "It has geitonogamy, xenogamy, contact (with direct contact of anthers and stigma) and gravitational autogamy; in Cucurbita maxima, cultivar Spanish 73 and in C. moschata, cultivar Palav-kadu 268 xenogamy and heitenogamy; in bisexual pumpkin flowers, in addition, there is contact, gravitational and ombroautogamy - with the help of rain, which occasionally falls during the flowering phase.

The melanocarpa (cross-pollinating plant) is characterized by xenogamy and heitenogamy.

Pollination is carried out by insects and wind (anemophily). Apompsis is possible.
Studying the pollination ecology of alfalfa (Medieago saliva L.) in the forest-steppe Trans-Urals - in species of the genus Glycyrrhiza L. in the conditions of the Tashkent region, established 5 types of subsidence depression: midday, sultry dry, short-term bad weather, long-term post-weather and biocenotic. For successful pollination of flowers and obtaining a high yield of pumpkin fruits, not only favorable weather conditions during the flowering period are necessary, but also a biocenotic environment that provides a stable and sufficiently large population of bees. According to our observations, the main reason for low seed productivity and low quality of pumpkin fruits is the biocenotic pollination depression.
For the effective setting of pumpkin fruits, it is necessary to get a large amount of pollen on the stigma. For the formation of 1 seed, 2.6-83.5 pollen grains are required. The number of ovules in the ovary of melon, cucumber, watermelon, and pumpkin varies from 150 to 700 or more [4, 5, 10, 19, 20].
According to the pumpkin growing areas, 1 hive is required per 1 hectare of crops. An increase in the number of pollinating insects increases the yield. During the mass flowering of gourds, the work of bees is very orderly. Flying from flower to flower, they move along the row. The chaotic movement of bees occurs only when there are few flowering plants. Having finished flying over one field, the bee always cleans the pollen into "baskets". Studies [14] found that when pollinating 1 flower with 900–1500 pollen grains, the yield of seeds from 1 fruit, depending on the variety, varies from 385 to 510.
It has been experimentally substantiated that the placement of bee hives near seed and commercial crops of melon, watermelon and pumpkin significantly increases the yield, quality of fruits and seeds [1, 3].
The need for bees for pollination is determined by the biological characteristics of plants and their growth conditions (soil fertility, moisture availability, etc.). The size of the apiary depends on the area of the site, the strength of bee colonies, and their number per 1 ha of pollinated crop, the presence of specific honey flora, weather conditions, etc. Bees must be brought to the crops in a timely manner, placing them as close as possible to the plants. It is necessary to use strong bee families that meet the requirements of SS 20728 - 75, occupying 8 frames of the vulture in spring, and later - more than 10.
In summer, bees are transported mainly by motor vehicles. Preparing families for transportation requires a lot of attention. It is first necessary to remove all the frames from the nests with a large amount of honey so that the honeycombs do not come off on the road and the bees are not flooded with honey. Hives are transported in the evening, at night or early in the morning. To ensure intensive cross-pollination of plants in all areas, bees should be placed taking into account the flight range.
For even distribution of bees, hives are best arranged in groups along the longer side of the crop area. On large areas (up to 2 km), the organization of the so-called counter pollination is required - the placement of 2 apiaries on opposite sides. The optimal distance for effective pollination is 300–500 m (Tables 2, 3).

Table 2.Visiting by bees of melons depending on the remoteness of the apiary, pieces/100m² (average for 2020 - 2021)

Distance from the site, m	Melo chandalak – Kichkintoy	Citrullus vulgaris – Shirin	Cucurbita maxima – Spain 73
10	150	140	190
300	90	100	130
500	70	70	100
800	40	50	60
1200	35	25	30
1500	20	20	20

Hives are placed in pairs in the same order as in the old place. It is better to place them among trees or shrubs so that the bees have good reference points.
It is necessary to bring hives at the very beginning of flowering in order to pollinate the first flowers, which form the largest fruits and high-quality seeds. If the bees are brought to the site a few days before the flowering of plants, then in search of nectar they will disperse over the area and begin to visit wild honey plants within a flight radius.
Quite effectively, bees visit watermelon and pumpkin flowers from a distance of no more than 500 m from the apiary. The most important condition for increasing the yield of fruits and the quality of seeds is the timely delivery and proper placement of apiaries. With an increase in the distance between apiaries, the yield decreases significantly and the quality of the seeds deteriorates.
In a hot climate, the location of the water source is essential for bees. To reduce the temperature in the nest and keep it moist, the bees spray the hearth over the combs.

If there is no good source of water nearby, you need to install a drinking bowl in the apiary and periodically add water to it, since in summer in dry hot weather the bees suffer greatly from thirst. For 1 bee family per day, 0.5 liters of water is enough.

The training of bees for smell is carried out by feeding them with sugar syrup with the smell of pumpkin flowers. In the evening, 50% sugar syrup is prepared.

Table 3. Germination of melons seeds obtained by bee pollination, depending on the distance from the apiary (average for 2019 - 2021)

Distance from apiary	Melo chandalak – Kichkintoy		Citrullus vulgaris – Shirin		Cucurbita maxima – Spain 73	
	Weight of 1000 seeds, g	Germination,%	Weight of 1000 seeds, g	Germination,%	Weight of 1000 seeds, g	Germination,%
10	55±7,3	98±1,9	175±8,4	99±1,0	435±12,3	98±. 1.8
300	53±8,4	983=1,8	170±7,6	99±1,0	430±11,8	98±.2.0
500	50±6,2	96±2,1	170±6,4	99±1,0	430±11,0	98±1,9
800	50±5,4	96±1,8	168±7,2	98±1,8	425±10,1	97±1,8
1200	50±5,4	94±1,7	165±6,4	96±1,7	420±9,2	92±1,6
1500	48±4,9	94±2,6	160±5,8	96±1,6	420±8,8	90±1,7

After cooling to room temperature, corollas of freshly cut pumpkin or watermelon flowers (1/3 of the syrup volume) are placed in it and the vessel is closed. Flavored syrup is distributed to bees daily in the morning before the start of summer, 100 g per colony during the entire period of pollination. The syrup is poured into the feeders, which are placed across the frames.

The absence of specific honey plants activates the pollination activity of bees. Therefore, seed crops of pumpkin are recommended to be placed far away (at least 3 km) from highly nectar-bearing entomophilous crops, and weeds should be mowed before flowering.

CONCLUSIONS

1. Species of the genera Melo (M. chandalak, M. ameri, M. zard, M. agretis) as well as Cucurbita moschata and Citrullus lanatus are monoecious polygamous plants. Bryonia melanocarpa, Cucumis sativus and Cucurbita maxima are actually monoecious (monoecious) plants.

2.All studied species are characterized by a pronounced polymorphism of flowers. The variety of sexual types of the flower and the degree of sex expression are specific to the species and variety. Bryonia melanocarpa has 2 flower types, 6 male and female, species of the genus Melo have 5: 1) a male flower with a rudimentary pistil; 2) a truly male flower; 3) bisexual (hermaphroditic) flower with normally developed pistil and stamens; 4) a female flower with rudimentary stamens; 5) a truly feminine flower.

3.The number of flowers of different sexual types and their location on shoots in representatives of the genera Bryonia, Melo, Cucumis, Citrullus and Cucurbita are not the same. Common to species, forms and varieties of melon, cucumber, watermelon and pumpkin (with the exception of B. melanocarpa) is the quantitative predominance of male flowers. So, on a melon plant during the growing season of staminate flowers, 7-26 times more pistillate flowers are formed. Staminate flowers are the most in variety Obi-novvot (443), less in variety Bosvaldy 2417 (113), pistillate flowers in wild weedy melon (27) and variety Ala-puchak (8-9), respectively.The ratio of male and fruit-forming (female and bisexual) flowers depends on environmental factors. To stimulate flowering and fruiting, it is advisable to use the growth regulators Hydel and Campozap at doses of 400 mg/l a.i. in the 2-3 leaf phase. Growth regulators increase the number of fruit-forming flowers, accelerate fruit ripening, and increase seed yield.

4. In the representatives of the family Cucurbitaceae studied by us, the opening of flowers is acropetalous. The type of blooming and opening of flowers is daytime (with the exception of M. flexuosis, in which the type of flowering is nocturnal). The peak of flowering in the daily rhythm depends on temperature, relative humidity and the activity of pollinating insects.

6. The method of pollination of gourds is entomophilous, it is dynamic and tapoceptive. The type of pollination is mainly xenogamous and heitenogamous. Autogamy is also noted in watermelon and pumpkin, and forced autogamy in melon. Pollinators for species and genera are specific. During hybridization work, it is necessary to pollinate the first opened female or bisexual flowers that open later, do not produce highly valuable fruits and seeds.

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