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# MORPHOLOGY OF FLORAL COMPATIBILITY AMONG SOME MANGO CULTIVARS

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**Abstract:** Four mango cultivars namely Hindi Be Sinnara, Pairi, Alphonso and Mabrouka were used to study morphology of pollen compatibility among the four cultivars and relationship of mating system among the four cultivars with fruit set under Assiut environmental conditions during 2005, 2006 and 2007 seasons.

Results showed that pollen germination and tube growth take 4 days to reach the stylar base. Selfing of either cultivar induced lower number of pollen tubes at style bases compared to outcrossing (open and crossing to other cvs.) and as a result, complete fruit drop occurred when the 4 cultivars were pollinated by hand selfing; hence there is self-incompatibility in all 4 cultivars.

Cross pollination between Alphonso and Mabrouka cvs. resulted in alternatively improved fruit retention. On the other hand, Alphonso cv. was a high fertile pollinator to Hindi Be Sinnara cv., which in turn was a high fertile pollinator to Pairi cv. So, this study recommends that these four cultivars should be accordingly cross pollinated to get a heigher yield.

**Key words**: mango, pollination, compatibility, fruit set.

## Introduction

Many cultivated plants are self-incompatible, but only with a plant that is vegetatively propagated plant and cultivated as a clone for the fruit or seed. Incompatibility is an important factor in the crop produced. Vegetatively propagated fruit trees, on the other hand will only be compatibly pollinated if two or more of the right cultivars are planted together, thus a detailed knowledge of compatibility and incompatibility in fruit trees has been essential for modern commercial fruit growing ( Sharma and Singh, 1972).

Many investigations were conducted to solve the problem of self-incompatibility of some mango cultivars (Sharma and Singh, 1970; Sharma and Singh, 1972; El-Kady, 1973; Mukherjee and Banerjee, 1976; Singh, 1978; Gunjate *et al.*, 1983; Rao *et al.*, 1984 and Desai *et al.*, 1985).

Moreover, Desai and Bhandwalkar (1995) studied self-compatibility in mango cultivars Alphonso, Totapuri, Langra, Vanraj and Baramasi as well as compatibility using pollen from cv. Kesar. They found that four of five cultivars were self-compatible, Langra cultivar being the exception. Kesar pollen increased percentage of fruit set in Alphonso and Vanraj but reduced it in Totapuri and Baramasi compared with selfing. Meanwhile, Abou El-Nasr *et al.* (1997) reported that germination of Zebda pollen on Taimour stigma was poor and the pollen tubes grew very slowly. Moreover, pollination of mango flowers with Hindi pollen showed abnormal cultivars. Also, Taimour self-pollination revealed variable degrees of self-incompatibility, where pollen tubes showed terminal plugs and failed to reach the end of the style. In addition, Afifi (1999) found that microscopic examination revealed that both Langra" and "Fajri Kalan" cvs. are self-incompatible cultivars.

The present study aimed to investigate morphology of pollen compatibility among the four cultivars; i.e. Hindi Be Sinnara, Pairi, Alphonso and Mabrouka under the study for better productivity.

**Materials And Methods**

This study was conducted during 2005, 2006 and 2007 seasons at a private orchard in Sahel-Saleem district, Assiut Governorate and laboratory Botany at the Faculty of Science, Assiut University. Four mango cultivars (*Mangifera indica* L.) namely Hindi Be Sinnara, Pairi, Alphonso and Mabrouka were used for this study; i.e Pairi, Alphonso and Mabrouka cultivars have monobryonic seeds while Hindi Be sinnara cultivar has polyembryonic seeds. Six healthy grafted trees from each cultivar were randomly selected. All selected trees were 20 years old, budded on seedling rootstocks and planted intermittently as a square system at 6 m apart in a loamy sand soil and subjected to the same horticultural practices.

The investigation dealt with the following studies:

**1 – Pollination studies:**

Complete diallel crosses in addition to a) open pollination; OP; b) hand selfing were made for each cultivar as follows:

1 - In Hindi Be Sinnara cultivar:

a- Open pollination.

b- Hand selfing pollination.

c-Cross pollination by Pairi pollens.

d-Cross pollination by Alphonso pollens.

e-Cross pollination by Mabrouka pollens.

2 - In Pairi cultivar:

a- Open pollination.

b- Hand selfing pollination.

c-Cross pollination by Hindi Be Sinnara pollens.

d-Cross pollination by Alphonso pollens.

e- Cross pollination by Mabrouka pollens.

3 - In Alphono cultivar:

a- Open pollination.

b- Hand selfing pollination.

c-Cross pollination by Hindi Be Sinnara pollens.

d-Cross pollination by Pairi pollens.

e-Cross pollination by Mabrouka pollens.

4 - In Mabrouka cultivar:

a- Open pollination.

b- Hand selfing pollination.

c- Cross pollination by Hindi Be Sinnara pollens.

d-Cross pollination by Pairi pollens.

e-Cross pollination by Alphonso pollens.

For the open pollination treatment, the flowers were left under the natural conditions of the orchard. For hand selfing pollination treatment, the pollen grains of the same cultivar were used for pollinating after emasculation. The emasculated flowers were then exposed to pollens brought in paper bag and then were covered with cloth bags.

For cross pollination treatments, the pollen grains of each cultivar were used for pollinating the female parent and then covered with cloth bags. All replicates were sprayed at the baloon stage with promalin (BA + $GA_{4+7}$) at the concentration of 10 ppm (Ebeed, 1996 and Boshra, 2003).

After 20 days of pollination, the protecting cloth bags were removed.

**2 – Pollen tube growth:**

Flowers were emasculated about one day before flower opening. Hand emasculation was accomplished by removing corolla and stamen ring. Crossing and a selfing were done by transferring pollen grains to ninety basal flowers on randomly taken inflorescences in each replicate. Five of pollinated flowers from each cross were fixed in F.A.A. (formalin-acetic acid-Alcohol 70%, 5:5:90 v/v/v) every day for 7 days after pollination for microscopic studies. The rest of the pollinated flowers were left on the plants until matured.

Sampled pistils were softened in 8 N NaOH for 2 hours, washed with tap water for 15 minutes, stained for 6 hours in 0.1% aniline blue, dissolved in 0.1 N $K_2PO_4$, mounted in glycerin and examined by fluorescence microscopy (Kho and Baer, 1968 and El-Agamy *et al.*, 1982).

**3 – Influences of mating system on fruit set:**

**3.1.** Initial fruit set %:

The percentage of initial fruit set was calculated 15 days after pollination as

$$\frac{\text{Total number of initial set fruits}}{\text{Total number of pollinated flowers}} \times 100$$

**3.2.** Fruit retention %:

Fruit retention percentage was calculated as follows:

$$\frac{\text{Total number of retained fruits}}{\text{Total number of pollinated flowers}} \times 100$$

This experiment was designed as a complete randomized (CR) and comparison among means were made using L.S.D. test at 5% level according to Steel and Torrie (1980).

**Results and Discussion**

**1 – Pollen tube growth:**

Pollen germination and pollen tubes which reached the bases of styles at each mating system were traced using the fluorescent microscopy technique (Table 1).

Data generally indicated the following remarks:

A- Pollen germination and tube growth take 4 days to reach the stylar base.

B- Selfing of either cultivar induced lower number of pollen tubes at stylar bases compared to outcrossing (open and crossing to other cvs.).

In Hindi Be Sinnara cv., relatively lower number of pollen tubes (PTs) reached to stylar bases; 8, 5, 10 and 6 Pts were recorded when such cultivar was open pollinated and crossed with Pairi, Alphonso and Mabrouka cvs., respectively, while only 1 PT was recorded in selfing of Hindi Be Sinnara. The largest number of PTs reaching the stylar base occurred when Hindi Be Sinnara cv. was crossed by Alphonso pollen (10 PTs), i.e. Alphonso cv. is a high fertile pollinator to Hindi Be Sinnara cv.

In Pairi cv., the number of pollen tubes reaching stylar bases were, 7, 9, 6 and 5 PTs when such cultivar was open pollinated and crossed with Hindi Be Sinnara, Alphonso and Mabrouka, respectively, while 2 PTs were recorded in selfing of Pairi pollen. The highest number of PTs reaching the stylar end in Pairi cv. was 9 PTs when it was crossed by Hindi Be Sinnara pollen, i.e. Hindi Be Sinnara is a high fertile pollinator to Pairi cv.

In Alphonso cv., number of pollen tubes reaching stylar bases occurred, 8, 6, 5 and 9 PTs were

recorded when such cultivar was open pollinated and crossed with Hindi Be Sinnara, Pairi and Mabrouka cvs., respectively, while 1 PT was recorded in selfing of Alphonso pollen. The highest number of PTs reaching the stylar end in Alphonso cv. was 9 PTs when crossed by Mabrouka pollen, i.e. Mabrouka cv. is a high fertile pollinator to Alphonso cv.

**Table(1):** Pollen tube number of Hindi Be Sinnara, Pairi, Alphonso and Mabrouka mango cultivars through different mating system.

| Female parent | Days after pollination | Pollen parent | | | | |
|---|---|---|---|---|---|---|
| | | Open | Hindi Be Sinnara | Pairi | Alphonso | Mabrouka |
| Hindi Be Sinnara | 1 | 0 | 0 | 0 | 0 | 0 |
| | 2 | 1 | 0 | 2 | 3 | 2 |
| | 3 | 5 | 1 | 4 | 7 | 5 |
| | 4 | 8 | 1 | 5 | 10 | 6 |
| | 5 | 8 | 1 | 5 | 10 | 6 |
| | 6 | 8 | 1 | 5 | 10 | 6 |
| | 7 | 8 | 1 | 5 | 10 | 6 |
| Pairi | 1 | 0 | 0 | 0 | 0 | 0 |
| | 2 | 2 | 2 | 1 | 1 | 2 |
| | 3 | 4 | 7 | 2 | 3 | 4 |
| | 4 | 7 | 9 | 2 | 6 | 5 |
| | 5 | 7 | 9 | 2 | 6 | 5 |
| | 6 | 7 | 9 | 2 | 6 | 5 |
| | 7 | 7 | 9 | 2 | 6 | 5 |
| Alphonso | 1 | 0 | 0 | 0 | 0 | 0 |
| | 2 | 2 | 3 | 2 | 0 | 4 |
| | 3 | 4 | 5 | 3 | 1 | 6 |
| | 4 | 8 | 6 | 5 | 1 | 9 |
| | 5 | 8 | 6 | 5 | 1 | 9 |
| | 6 | 8 | 6 | 5 | 1 | 9 |
| | 7 | 8 | 6 | 5 | 1 | 9 |
| Mabrouka | 1 | 0 | 0 | 0 | 0 | 0 |
| | 2 | 3 | 2 | 3 | 2 | 1 |
| | 3 | 5 | 4 | 4 | 6 | 1 |
| | 4 | 7 | 5 | 6 | 9 | 2 |
| | 5 | 7 | 5 | 6 | 9 | 2 |
| | 6 | 7 | 5 | 6 | 9 | 2 |
| | 7 | 7 | 5 | 6 | 9 | 2 |

In Mabrouka cv., number of pollen tubes reaching stylar bases; 7, 5, 6 and 9 PTs were recorded when such cultivar was open pollinated and crossed with Hindi Be Sinnara, Pairi and Alphonso cvs., respectively, while only 2 PTs were recorded in selfing of Mabrouka pollen. The highest number of PTs reaching the stylar end in Mabrouka cv. was 9 PTs when crossed by Alphonso pollen.

In conclusion, male parent should be put in consideration in inducing enough number of pollen tubes growth to fertilize ovules in the ovary which ensure fertilization and therefore reduced fruit drop resulted in higher yield (El-Agamy *et al.*, 1982 and Boshra, 2003).

**2 - Influences of mating on fruit set:**

**2.1- Initial fruit set (IFS):**

The effect of different pollination treatments on initial fruit set percentage of Hindi Be Sinnara, Pairi, Alphonso and Mabrouka mango cultivars during 2005, 2006 and 2007 seasons are presented in Table (2).

**Hindi Be Sinnara cultivar:**

From the data presented in Table (2) it could be revealed that cross pollination with Alphonso improved initial fruit set. The percentages in this respect were 27.4, 25.9 and 28.2 during 2005, 2006 and 2007 seasons, respectively (average of 27.17). On the other hand, hand selfing pollination gave the lowest percentages of initial fruit set. Such percentages were 7.7, 6.8 and 7.9 during the same seasons, respectively (average of 7.47).

As the average of three seasons, open pollination, hand selfing pollination, cross pollination with Pairi, Alphonso and Mabrouka cvs. gave 24.23, 7.47, 18.57, 27.17 and 19.93%, respectively.

**Pairi cultivar:**

From the data presented in Table (2) it could be showed that cross pollination with Hindi Be Sinnara gave a higher initial fruit set percentage. The percentages in this respect were 28.0, 29.1 and 27.3 during 2005, 2006 and 2007 seasons, respectively (average of 28.13). On the other hand, selfing pollination gave a lowest percentage of initial fruit set. Such percentages were 7.2, 8.0 and 6.7 during the same seasons, respectively (average of 7.21).

As the average of three seasons, open pollination, hand selfing pollination, cross pollination with Hindi Be Sinnara, Alphonso and Mabrouka cvs. gave 22.63, 7.21, 28.13, 21.8 and 20.63%, respectively.

**Table(2):** Effect of different pollination treatment on initial fruit set percentage in Hindi Be Sinnara, Pairi, Alphonso and Mabrouka mango cultivars during 2005, 2006 and 2007 seasons.

| Cultivar \ Pollination | | Open | Hand selfing | Cross pollination (♂) | | | L.S.D. 0.05 |
|---|---|---|---|---|---|---|---|
| | | | | Pairi | Alphonso | Mabrouka | |
| Hindi Be Sinnara | 2005 | 24.1 | 7.7 | 18.3 | 27.4 | 20.0 | 2.63 |
| | 2006 | 23.6 | 6.8 | 17.8 | 25.9 | 18.9 | 2.50 |
| | 2007 | 25.0 | 7.9 | 19.6 | 28.2 | 20.9 | 2.71 |
| | Avg. | 24.23 | 7.47 | 18.57 | 27.17 | 19.93 | |

| Cultivar \ Pollination | | Open | Hand selfing | Cross pollination (♂) | | | L.S.D. 0.05 |
|---|---|---|---|---|---|---|---|
| | | | | Hindi Be Sinnara | Alphonso | Mabrouka | |
| Pairi | 2005 | 22.3 | 7.2 | 28.0 | 21.5 | 20.6 | 2.59 |
| | 2006 | 24.6 | 8.0 | 29.1 | 22.9 | 21.5 | 2.70 |
| | 2007 | 21.0 | 6.7 | 27.3 | 20.4 | 19.8 | 2.48 |
| | Avg. | 22.63 | 7.21 | 28.13 | 21.6 | 20.63 | |

| Cultivar \ Pollination | | Open | Hand selfing | Cross pollination (♂) | | | L.S.D. 0.05 |
|---|---|---|---|---|---|---|---|
| | | | | Hindi Be Sinnara | Pairi | Mabrouka | |
| Alphonso | 2005 | 25.6 | 9.7 | 22.8 | 21.3 | 27.7 | 2.81 |
| | 2006 | 27.0 | 10.0 | 24.9 | 22.6 | 29.4 | 2.94 |
| | 2007 | 26.2 | 8.9 | 23.7 | 21.0 | 28.1 | 2.75 |
| | Avg. | 26.27 | 9.53 | 23.80 | 21.63 | 28.40 | |

| Cultivar \ Pollination | | Open | Hand selfing | Cross pollination (♂) | | | L.S.D. 0.05 |
|---|---|---|---|---|---|---|---|
| | | | | Hindi Be Sinnara | Pairi | Alphonso | |
| Mabrouka | 2005 | 23.6 | 8.4 | 20.5 | 22.4 | 27.7 | 2.78 |
| | 2006 | 24.4 | 8.8 | 21.0 | 22.9 | 29.2 | 2.86 |
| | 2007 | 25.0 | 9.3 | 21.7 | 23.3 | 30.0 | 2.92 |
| | Avg. | 24.33 | 8.83 | 21.07 | 22.87 | 28.97 | |

**Alphonso cultivar:**

From the data in Table (2) showed that cross pollination with Mabrouka gave a higher initial fruit set percentage. The percentages in this respect were 27.7, 29.4 and 28.1 during 2005, 2006 and 2007 seasons, respectively (average of 28.4). On the other hand, selfing pollination gave a lowest percentage of initial fruit set. Such percentages were 9.7, 10.0 and 8.9 during the same seasons, respectively (average of 9.53).

As the average of three seasons, open pollination, hand selfing pollination, cross pollination with Hindi Be Sinnara, Pairi and Mabrouka cvs. gave 26.27, 9.53, 23.80, 21.63 and 28.40%, respectively.

**Mabrouka cultivar:**

Data presented in Table (2) showed that cross pollination with Alphonso gave a higher initial fruit set percentage. The percentages in this respect were 27.7, 29.2 and 30.0 during 2005, 2006 and 2007 seasons, respectively (average of 28.97). On the other hand, selfing pollination gave a lowest percentage of initial fruit set. Such percentages were 8.4, 8.8 and 9.3 during the same season, respectively (average of 8.83).

As the average of three seasons, open pollination, cross pollination with Hindi Be Sinnara, Pairi and Alphonso cvs. gave 24.33, 8.83, 21.07, 22.87 and 28.97%, respectively.

**2.2- Fruit Retention (FR)**

The effect of different pollination treatments on fruit retention percentage of Hindi Be Sinnara, Pairi, Alphonso and Mabrouka mango cultivars during 2005, 2006 and 2007 seasons is presented in Table (3).

In Hindi Be Sinnara cv., the highest fruit retention value was observed in cross pollination with Alphonso cv. (1.78% as average of the 3 seasons) compared to open pollination, hand selfing and cross pollination with Pairi and Mabrouka cvs. (1.48, 0.00, 1.24 and 1.35%, respectively, as averages of the 3 seasons). This indicates that self-incompatibility is present in such cultivar and Alphonso cv. is a high fertile pollinator to Hindi Be Sinnara cv.

In Pairi cv., the highest FR value was observed in cross pollination with Hindi Be Sinnara cv. (1.90% as average of the 3 seasons) compared to open pollination, hand selfing and cross pollination with Alphonso and Mabrouka cvs. (1.77, 0.00, 1.73 and 1.63%, respectively, as 3 years average). This shows that self-incompatibility is present in such cultivar and Hindi Be Sinnara cv. is a high fertile pollinator to Pairi cv.

**Table(3):** Effect of different pollination treatment on fruit retention percentage in Hindi Be Sinnara, Pairi, Alphonso and Mabrouka mango cultivars during 2005, 2006 and 2007 seasons.

| Pollination / Cultivar | | Open | Hand selfing | Cross pollination (♂) | | | L.S.D. 0.05 |
|---|---|---|---|---|---|---|---|
| | | | | Pairi | Alphonso | Mabrouka | |
| Hindi Be Sinnara | 2005 | 1.48 | 0.00 | 1.24 | 1.80 | 1.36 | 0.16 |
| | 2006 | 1.42 | 0.00 | 1.18 | 1.69 | 1.28 | 0.16 |
| | 2007 | 1.54 | 0.00 | 1.30 | 1.84 | 1.42 | 0.17 |
| | Avg. | 1.48 | 0.00 | 1.24 | 1.78 | 1.35 | |

| Pollination / Cultivar | | Open | Hand selfing | Cross pollination (♂) | | | L.S.D. 0.05 |
|---|---|---|---|---|---|---|---|
| | | | | Hindi Be Sinnara | Alphonso | Mabrouka | |
| Pairi | 2005 | 1.78 | 0.00 | 1.90 | 1.70 | 1.62 | 0.19 |
| | 2006 | 1.86 | 0.00 | 1.98 | 1.84 | 1.70 | 0.20 |
| | 2007 | 1.66 | 0.00 | 1.82 | 1.66 | 1.56 | 0.18 |
| | Avg. | 1.77 | 0.00 | 1.90 | 1.73 | 1.63 | |

| Pollination / Cultivar | | Open | Hand selfing | Cross pollination (♂) | | | L.S.D. 0.05 |
|---|---|---|---|---|---|---|---|
| | | | | Hindi Be Sinnara | Pairi | Mabrouka | |
| Alphonso | 2005 | 1.63 | 0.00 | 1.48 | 1.30 | 1.75 | 0.18 |
| | 2006 | 1.77 | 0.00 | 1.60 | 1.38 | 1.84 | 0.19 |
| | 2007 | 1.68 | 0.00 | 1.40 | 1.27 | 1.80 | 0.18 |
| | Avg. | 1.69 | 0.00 | 1.49 | 1.32 | 1.80 | |

| Pollination / Cultivar | | Open | Hand selfing | Cross pollination (♂) | | | L.S.D. 0.05 |
|---|---|---|---|---|---|---|---|
| | | | | Hindi Be Sinnara | Pairi | Alphonso | |
| Mabrouka | 2005 | 1.70 | 0.00 | 1.50 | 1.66 | 1.92 | 0.19 |
| | 2006 | 1.74 | 0.00 | 1.56 | 1.70 | 1.98 | 0.21 |
| | 2007 | 1.82 | 0.00 | 1.62 | 1.80 | 2.12 | 0.23 |
| | Avg. | 1.75 | 0.00 | 1.56 | 1.72 | 2.01 | |

In Alphonso cv., cross pollination with Mabrouka cv. improved FR of such cultivar (1.80% as average of the 3 seasons) compared to open pollination, hand selfing and cross pollination, with Hindi Be Sinnara and Pairi cvs. (1.69, 0.00, 1.49 and 1.32%, respectively, as average of 3 seasons). This shows that self incompatibility is present in such cultivar and Mabrouka cv. is a high fertile pollinator to Alphonso cv.

In Mabrouka cv., cross pollination with Alphonso cv. improved FR of such cultivar (2.01% as average of the 3 seasons) compared to open pollination, hand selfing and cross pollination with Hindi Be Sinnara and Pairi cvs. (1.75, 0.00, 1.56 and 1.72%, respectively, as average of 3 seasons). This reveals that self incompatibility is present in such cultivar and Alphonso cv. is a high fertile pollinator to Mabrouka cv.

In conclusion, it is noticeable that complete fruit drop occurred when the four cultivars were pollinated by hand selfing, this indicated that self-incompatibility is present in the four cultivars.

Cross pollination between Alphonso and Mabrouka cvs. results in alternatively improving fruit retention. On the other hand, Alphonso cv. is a high fertile pollinator to Hindi Be Sinnara cv., meanwhile Hindi Be Sinnara cv. considerd a high fertile pollinator to Pairi cv. These results reveal the necessary of the four cultivars to be exposed to cross pollination for commercial yield.

These results are in agreement with early findings of Gunjate *et al.* (1983), Bohsra (2003) and Pinto *et al.* (2004) who reported that fruit retention was increased by cross pollination.

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# مورفولوجيا التوافق الزهرى فى بعض أصناف المانجو

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معهد بحوث البساتين – مركز البحوث الزراعية – مصر

أجريت هذه الدراسة خلال ثلاثة مواسم متتالية 2005 ، 2006 ، 2007م على أربعة أصناف من المانجو هندى بسنارة وبايرى والفونس ومبروكة المنزرعة ببستان خاص بمنطقة ساحل سليم بمحافظة أسيوط وذلك لدراسة درجة التوافق الزهرى بين هذه الأصناف .

وقد أثبتت النتائج أن إنبات حبوب اللقاح ونمو الأنبوبة اللقاحية داخل أنسجة القلم يستغرق أربعة أيام حتى تصل إلى قاعدة القلم ، كما كانت الأنابيب اللقاحية النامية داخل أنسجة المتاع فى التلقيح الذاتى أقل من العدد الكافى لإخصاب البويضات الموجودة بالمبيض مقارنة بالتلقيح الخلطى والمفتوح ونتيجة لذلك وصلت نسبة التساقط فى التلقيح الذاتى لهذه الأصناف الأربعة إلى 100% مما يدل على أن هذه الأصناف الأربعة عديمة التوافق الذاتى . أما بالنسبة للتلقيح الخلطى فإنه وجدت درجة توافق عالية ومتبادلة بين الصنفين الفونس ومبروكة بالإضافة إلى ذلك كان الصنف الفونس ملقح جيد للصنف هندى بسنارة أما الصنف بايرى فأفضل ملقح له كان الصنف هندى بسنارة .

لذا توصى هذه الدراسة بأهمية توافق الأصناف المستخدمة فى بستان المانجو حيث يجب اختيار الأصناف المتوافقة للحصول على أعلى محصول .