FLOWER POWER

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Maximising Kiwifruit production involves many inter-relating factors. It is essential not to look at these in isolation they all have an effect. At anyone time one factor will be limiting production the most. Management should do what it can to improve the situation.

The understanding of how your vine works and how the kiwifruit flower and pollination occurs are fundamental pieces of information required to have successful production.

In this paper I will look at where the flowers come from, what each flower is like, what happens during pollination and briefly introduce the concept of Artificial pollination.

The paper will hopefully provide you with an understanding of some of the terminology you will hear in subsequent papers.

KIWIFRUIT GROWTH CYCLE

It is assumed that we start with a basic trunk and a leader going both ways. We will also follow the growth of one vegetative bud for 2 seasons.

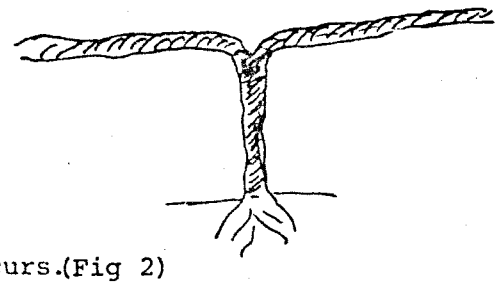


Fig 1. Basic Kiwifruit Vine Structure

In late August early September Bud burst occurs.(Fig 2)

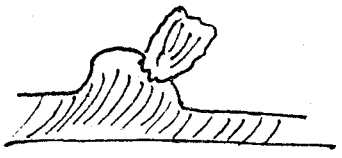
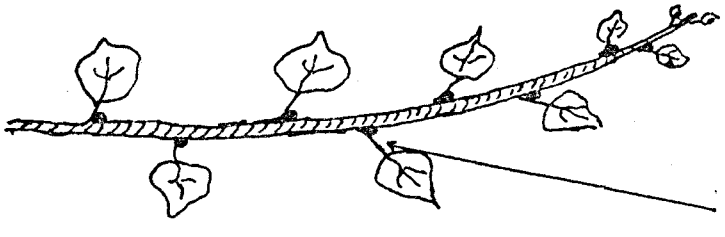


Fig 2. Bud burst

Extension growth continues through the growing season until end of April.

Fig 3. Full extension growth of the bud bursting in figure 2



In February-March flower evocation takes places in the buds contained within the leaf axils of this growth. Fig 4

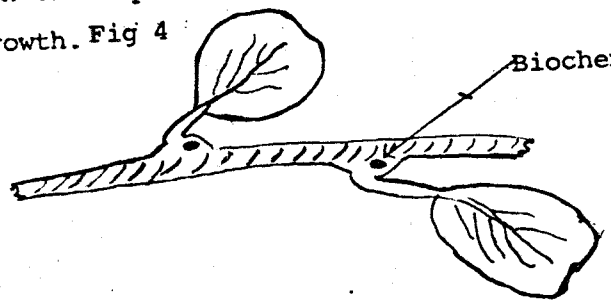


Fig 4. Flower evocation

A chemical change occurs which allows flower initiation development to take place in August-September in Year 2.

In June the leaves drop and last years extension growth now looks like Fig 5.

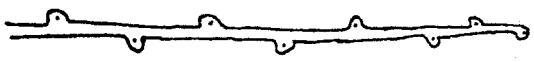


Fig 5. After leaf fall, now a fruiting cane with several evocated buds.

July-August Year 2 Winter Cold Period.

From late August onwards flower initiation is going on inside the bud which is getting ready to start growing.

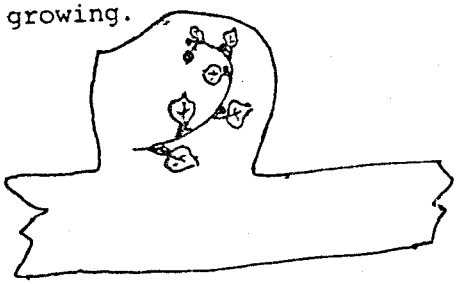


Fig 6. Flower initiation and early stages of flower development.

In early September Bud burst occurs and flower development continues

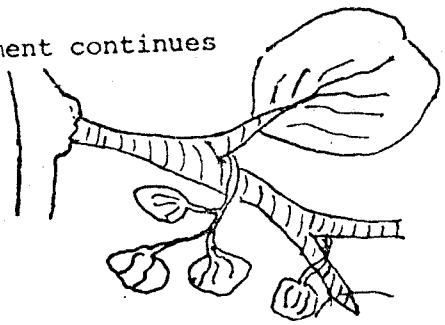


Fig 7. Bud burst and flower development

By 2nd-3rd week in November the flowers will be open and ready for pollination. Fig 8

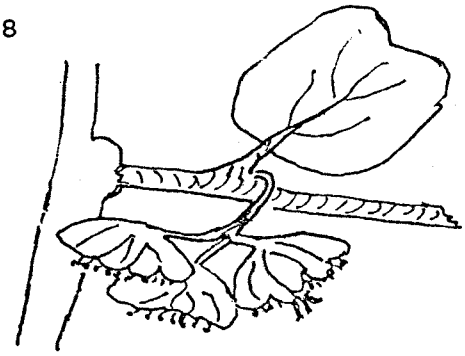


Fig 8. <u>Fully open Flowers.</u>

The main factors affecting the number of flowers will be the conditions at the time of evocation in February-March. If conditions are good and there is plenty of light, temperature and nutritional status are satisfactory, the crop potential due to the evocation process is likely to be high. The converse will be true. Another factor is the winter cold period. Experimental work and practical experience in different growing areas shows that extra cold can markedly increase the number of flowers per shoot. The cold temperature seems to prevent some flowers aborting.

Another major factor in determining how many flowers will occur in any season is the number of buds which break on a cane. Those which don't represent lost potential flower and crop. Winter cold is also thought to affect this.

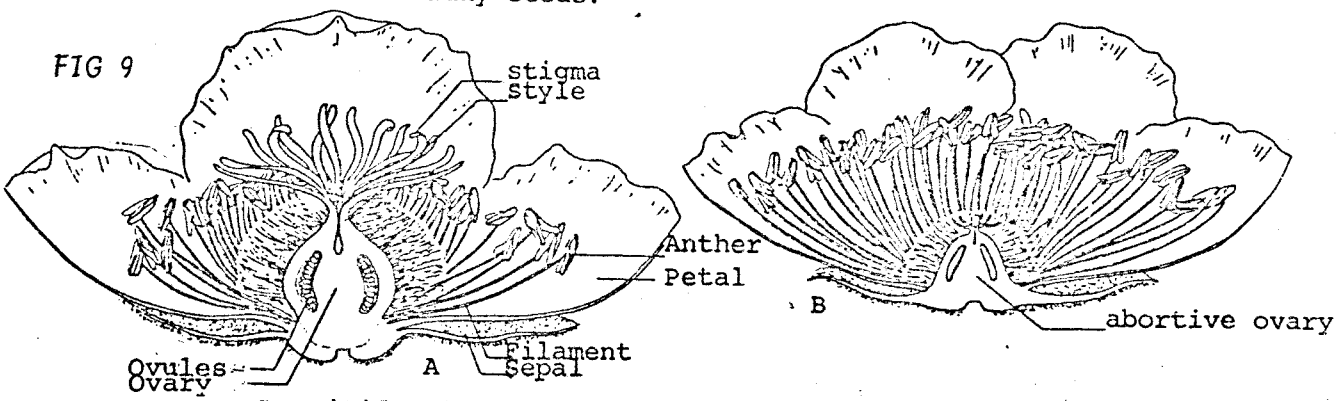
We now know how flowers arise and some of the things that affect the number of flowers per vine.

Now we can look at the flower structure and how it becomes a fruit.

FLOWER STRUCTURE

The Kiwifruit flower (see Figure 9.) is white changing to yellow with age, 3-5 cm in diameter and attractive. The ovary is many celled and it produces a fruit with many seeds.

FIG 9



Longitidunal section of kiwifruit flowers (A Female, B Male)

The (female) pistillate flower can be easily recognised by the swollen ovary below the base of the petals. There are several styles in the (female) pistillate flower which are also surrounded by numerous stamen that produce no viable pollen.

The (male) staminate flowers have a very small in-operative vestigal ovary surrounded by numerous stamens.

STRUCTURE OF STIGMA AND STYLE

Each stigma and style structure (see Figure 10.) ressembles a tube which in plan view opens out in a v at the top end which runs into a central furrow which extends half the length of the style where it joins the stylar canal. The top end of the style or stigma is covered in very small papillae or lumps. This v-opening becomes pronounced when the flower opens.

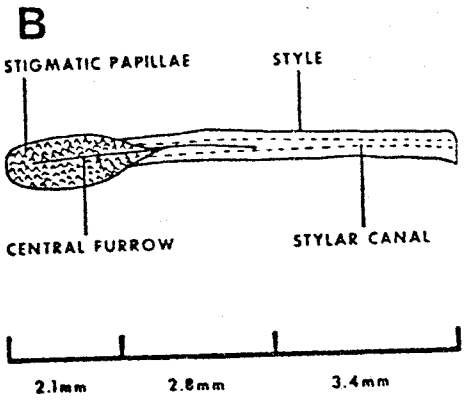


Fig 10. A schematic diagram of a kiwifruit style & stigma

POLLINATION

Occurs when the stigma is receptive and if viable pollen is transferred from anthers of a male kiwifruit flower to a stigma of a female flower. The pollen grain will adhere to one of the many papillae germinate and send a pollen tube bearing the tube nucleus and the two sperm nuclei down through the central furrow and stylar canal into the ovary and finally into one of the ovules.

Fertilisation follows the pollination process and occurs when sexual union between one of the two sperm nuclei and the egg nucleus of the ovule occurs. A viable seed is formed. Fruit development will now proceed.

POLLEN GERMINATION AND POLLEN TUBE GROWTH

Work by (Hopping and Jerram 1979) showed that seven hours after pollen deposition on the stigma some pollen grains had germinated on the papillae and their tubes had grown down the papillae and into the transmitting tissue. After 24 hours most pollen tubes had reached the junction between the style furrow and stylar canal.

They also established that under field conditions that the minimum effective pollen load is much less that the possible load that the stigmas could carry.

SEED COUNT AND FRUIT SIZE

Hopping (1976) showed that the relationship between seed numbers and fruit weight is non linear, and large gains in fruit weight occur as the maximum of 1400 seeds is approached.

It was showed that the weight of Hayward kiwifruit rose dramatically when seed numbers per fruit exceeded 1100. Obviously the number of seeds and the fruit weight then is in part an indication of how successful the pollination and fertilisation processes have been. The seeds provide stimuli for flesh development.

Now we have got some idea of the flower structure and the pollination process, I will briefly introduce the Topic of Artificial Pollination.

Losely you could call any pollination which occurs with mans interference including the introduction of bees as artificial..

I will be talking about pollen transfer not involving wind or insects. In its simplest form it could involve the manual rubbing of male flowers against female flowers which could involve approximately 125 hours per hectare of hand labour. 1 fresh male flower is rubbed against 5-6 female flowers and it is repeated every 3 - 4 days through flowering.

At its optimum stage of development spray pollination may (will) become an alternative pollen transfer method to bees which involves harvesting male kiwifruit flowers, extracting the pollen then spraying this on female flowers.

Pollen viability can be maintained in very pure non-ionic water with additional additives for up to 3 hours. Work by Hopping (1982) shows pollen so treated sprayed onto receptive flowers with hand operated sprayers increased seed numbers and fruit weight.

Similar trial work with conventional sprayer operating at 3.2 km/h ground speed has not been successful, because pollen viability decreasedrapidly during suspension pumping and insufficient pollen was deposited on the stigmatic surface of the flowers.

Successful spray pollination of kiwifruit will depend on obtaining pollen at low cost and then applying it specifically to the stigmas of respective receptive flowers every 3-4 days during flowering.

The system needs alot of improvement to overcome pollen viability drop-off while in suspension and to increase the amount of pollen reaching the receptive female flower parts.

This work is going on. Looking at ways of maintining viability and improving depositions. It is hoped that electrostatic spraying may help in the area of deposition.

Costings indicate that if spray pollination is to be economic, pollen concentration should not exceed 0.25 gms pollen/litre and application rates should not exceed 300L/hectare.

If this alternative becomes a viable one it may provide use with a very reliable means of pollen transfer which will hopefully mean more predictable yeilds. Possibly by changing pollen concentrations it could have a predictable influence on crop sizing which will become important when differential prices for sizes come in. Wishful thinking maybe. It may also mean we could have a complete Female Fruiting Canopy on the high value land.

Now you should have some idea of where the flowers come from, how they work and an insight into the development of an exciting possible alternative to pollen transfer by insect, spray pollination.

REFERENCES

HOPPING M E and JERRAM E M 1979 : Pollination of kiwifruit *(Actinidia chinensis* Planch.) : stigma-style structure and pollen tube growth. *New Zealand Journal of Botany, 1979, Vol. 17:233-40*

HOPPING M E 1982: Spray Pollination of Kiwifruit. *Reprinted from New Zealand Agricultural Science, Volume 16 (1), 1982 pp46-48)* Butterworths, Wellington (Publishers)

HOPPING M E and JERRAM E M 1980 : Supplementary pollination of tree fruits : *New Zealand Journal of Agricultural Research 23 (1980): 509-515*

HOPPING M E and SIMPSON L M 1982: Supplementary pollination of tree fruits: *N Z Journal of Agriculture Research 25 (1982): 245-250*