T1972PHY19

VEGETATIVE GROWTH, YIELD AND INDUSTRIAL QUALITY OF THREE SUNFLOWER CULTIVARS AS INFLUENCED BY DIFFERENT DATES OF PLANTING (1)

C. REMUSSI, H. SAUMELL et G.A. VIDAL APONTE (2) (Argentine)

INTRODUCTION

Sunflower (Helianthus annuus L.) date of planting has a great influence on the yield crop, both in seed production and oil content.

In Argentina there are two characteristic dates of planting : one of them begins in October and the other from middle December to the end of January. This last one is practiced in large areas in the N of Buenos Aires, S of Santa Fé, and SE of Cordoba Provinces, over a cereal stubble, trying to obtain two harvests in a year.

The reduced amount of seed needed in the sowing and its typical rusticity, are causes of the unthinkable election of sunflower date of planting and soils.

Delay in sunflower dates of planting, makes the maturity develop during humid Autumns which brings a difficult harvest and risks it because of the proliferation of diseases. Besides, yields decrease because the crop does not satisfy the minimum bioclimatic requirements for its normal growing and development, apart from the fertility and humidity in the soil.

By means of bioclimatic and phenometric indices and quality variations this work shows the convenient sowing dates of sunflower which produce the higher yields.

This trial was divided into two parts : the first analized the cultivars reaction when different temperatures and day lengths are present, and the second analized date of planting on phenometric characters and quality.

---

(1) This work was mainly sponsored with a special found for Scientific and Investigation belonging the Universidad of Buenos Aires.

(2) Head and Adjunct professors and Chief assistent of Industrial Crop's Chair of the Facultad de Agronomia y Veterinaria, Universidad of Buenos Aires, respectively.

MATERIAL AND METHODS

Experiments were conducted at Industrial Crop's experimental field of "Facultad de Agronomia y Veterinaria of Buenos Aires" - (lat. 34° 35' S ; long. 38° 29' W of G. -alt. 25 m).

Three cultivars, Precoz F.A.V., Guayacan INTA and Pehuen INTA, were used, making continued sowings at each 20 days from August 1969 to March 1972.

Each cultivar plot was five rows (4 m long at 0,70 m between each one) wide.

Seeds were planted at a rate of 2 or 3 at each 0,20 m in the row, having a stand of 100 plants with a spacing after emergence.

Date of planting, emergence, daily flowering and harvest were the phenological observations. The determination of beginning (20 % of plants), full (50 %) and end (80 %) of flowering was made with daily counting of flowered plants.

To protect from birds damage 20 azar elected heads were covered with polyethylene net bags which were analized at harvest for quality and phenometric characters. Analysis and Certification Laboratory of the Grain National Board analized oil content in seeds.

RESULTS AND DISCUSSION

I - PHENOLOGIC VARIATIONS AS AFFECTED BY DATE OF PLANTING

a) Planting-emergence subperiod

Plantings were made after a rain but sometimes, watering was necessary to assure emergence. During the three years experiments, it was verified that planting-emergence subperiod has a length within 5 and 22 days according to temperature and soil humidity after sowing. Figure 1 shows the relation between subperiod mean temperature and days from planting to emergence, three years and three cultivars.

In plantings of the end of May, when temperature of the subperiod was of 10°C, emergence was desuniform and 20 days delayed. Emergences with mean temperatures of 24-25°C lasted 6 days only.

Due to risks obtained with a delayed germination, and with the results of the experiment, sunflower planting is not recommended up to the month when mean temperature stabilizes, in approximately 15°C.

In contrast, Jensma (1970), in Holland, obtained a satisfactory emergence and beginning of growing with 5°C. Our experiments showed that planting with mean temperature of 10°C lasted many days and resulted desuniform, plants grew little, had many but reduced heads and almost the majority died. That made us suppose that dutch cultivars are adapted to low temperature.

b) Emergence-flowering subperiod

In figure 2, it is observed that flowering is produced either during long days of December or short days of June, but head diameter, number of fertile achenes by head, oil yield, etc..., vary enormously according to different dates of plantings.

Plants emerging just in winter, with very low temperatures, had head in the middle of September (Precoz FAV) or in the middle of October (Pehuen INTA and Guayacan INTA) after an enlarged vegetative growing period. In those plantings 60-80 % of plants died, due to frosts and, or putrefaction caused by fungus. As time of planting advanced, the flowering subperiod became shorter because thermic requirements were quickly satisfied. But when plantings of the end of February came, most of plants did not produce heads or did not open them, because did not satisfied minimum thermic requirements. Head produced, were 5 to 8 cm in diameter and plants had a reduced height. In March and April plantings, none of the varieties produced achenes.

During April emergences only Precoz FAV cultivar flowered and gave fruits, but after 4 months of vegetative growth.

The behaviour of Precoz FAV cultivar is quite different from the other two. In the first dates of planting precocity difference was very marked, but it sensibly diminished in posterior dates and were almost equal for the end of November and December emergences. During very late plantings, Precoz FAV increased differences again respect the other cultivars.

Figure 3 shows the number of days sunflower needs to flowering according to date of emergence. In Guyacan INTA y Pehuen INTA cultivars, the subperiod diminished from June to January, perhaps, because higher temperature gave major thermic disposal. However, with the posterior analysis of temperature summation it was observed that even when days to flowering were minor each time, thermic accumulation increased to 1.037° for Precoz FAV, to 1.131° for Pehuen INTA and to 1.200° for Guayacan INTA (all of them above 5°C), during December plantings. That is because to achieve flowering sunflower requires an adequate photoperiod besides temperature.

Flowering precocity differences between Guayacan INTA and Pehuen INTA in comparison with Precoz FAV was marked for the first dates of planting : 35 days for emergences in July to 20-25 days for emergences in August and September. Those differences were sensibly reduced in posterior sowings and almost equal for the end of November and December emergences. Precoz FAV has minimum subperiod lengths for emergences in October and January which flowered at the end of November and February, respectively. Emergences of November and December enlarged the subperiod considerably. This different behaviour respect the other cultivars is due to the intolerance of Precoz FAV flowering around summer soltice's long days.

Temperature summation residual method let a correct analysis for the amounts required for each subperiod because temperatures are summed above the "cero temperature" to growing.

Fig. 4 considers temperature summation above 5°C (T.S.5) which had the minor variability coefficient comparing with temperatures summation above 0°C, 10°C and 15°C.

Temperatures summation to flowering were quite similar for Pehuen INTA and Guayacan INTA but Precoz FAV had a different behaviour. During first plantings, in winter, thermic requirements were higher due to larger vegetative cycles determined by low temperatures. When air temperature increased, subperiod length and accumulation diminished, but the last increased again when September plantings began. This was because plants developed during constantly increasing days and temperatures, which determined a considerable accumulation of degree-day. When middle December emergences occured, thermic summation began to decrease.

Precoz FAV cultivar's curve had a different behaviour. June, July, August, September and October emergences needed lower temperature summations to flowering than Pehuen INTA and Guayacan INTA's. But differences decreased and were similar during end of November and beginning of December emergences for the three cultivars.

Precoz FAV cultivar's different behaviour can be explained through its intolerance to flowering around summer solstice's long days, which do not occur, so marked, with Pehuen INTA and Guayacan INTA cultivars.

These two cultivar's behaviour seems to be similar to the one that Allard and Garner (1940) found in their experiments. On the contrary, as Precoz FAV enlarges its cycle to flowering around Buenos Aires Summer's long days, it must be considered as a cultivar having a great response to short day photoperiods. If temperature causes flowering, to higher mean temperature few days will be required to complete the state.

Figure 5 relates subperiod mean temperature and the inverse of days.

Pehuen INTA and Guayacan INTA had points disposed in a right line.

In the beginning, with increasing mean temperature and few days needed, Precoz FAV increased the inverse. But with cycle's higher temperatures and the increasing days required, inverse decreased. This is

explained by the influence of day length. Ermergences anterior to October that flowered before summer solstice, had a shorter subperiod than November and December emergences, which developed through summer long days.

c) Planting - harvest period : Figure 6 shows vegetative cycle different lengths, according to date of planting in the three cultivars.

During first dates (winter plantings), cycle was long because all the subperiods enlarged. Harvests of all those first dates were almost in the same date.

When the three cultivars were compared among them, it was noticed that there existed a great difference of days up to harvest during first plantings, but it was little for end of November and December plantings.

Planting-harvest period shortened as dates of plantings advanced. This phenomenon was proportionally higher in Guayacan INTA and Pehuen INTA than in Precoz FAV.

March and April plantings did no fructify, except Precoz FAV which in April planting produced small and low yielded heads.

II - PHENOMETRIC VARIATIONS ACCORDING TO TIME OF PLANTING

For the latitude when the experiments were made there exist 6 months in the year allowing sunflower harvests but the restant months make them impossible. Sunflower has a normal cycle during plantings between August and January when all the plants flower and fructify.

When plantings are made between February and July, there are losts in plants and or uncompleted vegetative states with one or various rudimentary or deformed heads in the same plant. Generally, they do not fructify or do it defficiently.

a) Plant height :

It had its maximum with October and November plantings being progressively minor for those made after or before the mentioned months.

Guayacan INTA and Pehuen INTA had similar heights but superior to Precoz FAV's (fig. 7).

b) Head diameter :

It increased from winter planting, having its maximum in those of October and November. From those dates, the diameter began to decrease.

Precoz FAV produced the smaller head respect the two others (fig. 8).

c) Achenes weight by head :

The higher yield by plant was obtained with middle or end of November plantings, during the former or posterior it decreased significantly (fig. 9).

Plant height, head diameter, and weight of achenes by head have a similar tendency, showing the narrow relation among these components of yield. Maximum values are obtained when sunflower satisfy bioclimatic requirements adequately.

d) 1 000 achenes weight :

It was quite similar during the different dates of planting. Pehuen INTA had the minor values in almost all of them.

d) Normal achenes percentage by head :

Higher values were obtained with end of November or beginning of December emergences. The minor amount was produced with too late or too early plantings.

e) Normal achenes percentage by head :

Higher values were obtained with end of November or beginning of December emergences. The minor amount was produced with too late or too early plantings.

f) Vain fruits and not fecundated flowers by head :

Values obtained were not progressively constant, however, the three cultivars showed a tendency to produce more vain fruits or not fecundated flowers as well in early as in late plantings. In March and April plantings, only heads with not fecundated flowers were obtained. That was the effect of meteorological conditions during flowering, allowing or difficulting insects polliniferous labour.

g) Seed and pericarp percentage :

Since first plantings up to the end of December ones, seed weight increased in relation with pericarp, but it decreased in posterior plantings.

h) Oil content percentage :

It increased progressively from first plantings up to a maximum with early November plantings, when they began to decrease.

Pehuen INTA had higher oil content percentage in fruit, being followed by Guayacan and Precoz FAV (fig. 11).

CONCLUSIONS

1 - Sunflower planting is not recommended up to the moment when mean temperature stabilizes in approximate by 15°C.

2 - Sunflower flowering is produced the whole year : or with long days of December or with very short days of June, but phenometric characters vary according to date of planting.

3 - Days to flowering decrease from March to January and February in Guayacan INTA and Pehuen INTA cultivars. Precoz FAV cultivar has a particular behaviour because it enlarge its cycle when flowering is produced around summer solstice's long days.

4 - Thermic requirements during emergence-beginning of flowerings subperiod are each time higher since plants develop with constantly increasing days and temperatures. Precoz FAV cultivar accumulates the major thermic summation as it enlarge its cycle during solstice's long days.

5 - The relation between mean temperature and emergence-beginning of flowering subperiod and the inverse of days shows the development speed.

Pehuen INTA and Guayacan INTA react by diminishing the subperiod proportionally, when temperature increases. Precoz FAV is intolerant to long days and there is not a linear relation between temperature and subperiod length.

6 - During first plantings, in winter, vegetative cycle subperiods length is too large due to low temperatures.

Cultivars' behaviour differ in those plantings, but in posterior to September, subperiod length shortens with a minimum for January's.

7 - Plant height, head diameter, achenes weight by head, number of normal fruits, pip percentage and oil content percentage are relationed among them. Maximum values are obtained in early November plantings, in coincidence with maximum temperatures summations.

8 - This trial shows that too early or too late plantings do not allow good yields because of lower temperature disposal.

9 - Precoz FAV's precocity is manifested in early or late plantings, but in November, December and early January plantings differences up to harvest are minimum in relation to the other varieties.

BIBLIOGRAPHY

ALLARD H.A. and GARNER W.W. - 1940 - Further observations on the response of various species of plants to length of day. Tech. Bull. 727 U.S.D.A., p. 1-64.

ASPIAZU C. - 1971 - Pronostico de fases en cultivos de maiz dentado mediante sumas de temperaturas. Rev. Fac. Agr. y Vet. Bs. As. 19 (1-2) - 61-69

JENSMA J.R. - 1970 - Position of the sunflower in world Agriculture - Proceedings of the Fourth Internation. Sunflower Conference, Memphis, Tennessee, U.S.A. - 16-22.

PASCALE A.J. - 1969 - Tipos Agroclimaticos para el cultivo de la soja en la Argentina-Revista Fac. Agr. y Vet. 17 (3) - 31-48.

REMUSSI C. y GUTIERREZ H.P. - 1965 - Obtencion de una linea precoz de girasol (H. annuus) por tratamiento de "semillas" con rayos X. Pergamon Press - 603-609.

ROBINSON R.G. - 1970 - Sunflower date of planting and chemical composition at various growth stages. Agron. J. (62) - 5 - p. 665-66.

ROBINSON R.G. - 1971 - Sunflower phenology, year, variety, and date of planting effects on day and growing degree day summations - Crop Science 11 (5) - 635-638.

FIG. 6 - VEGETATIVE SUBPERIODS LENGTH
(5 years average)

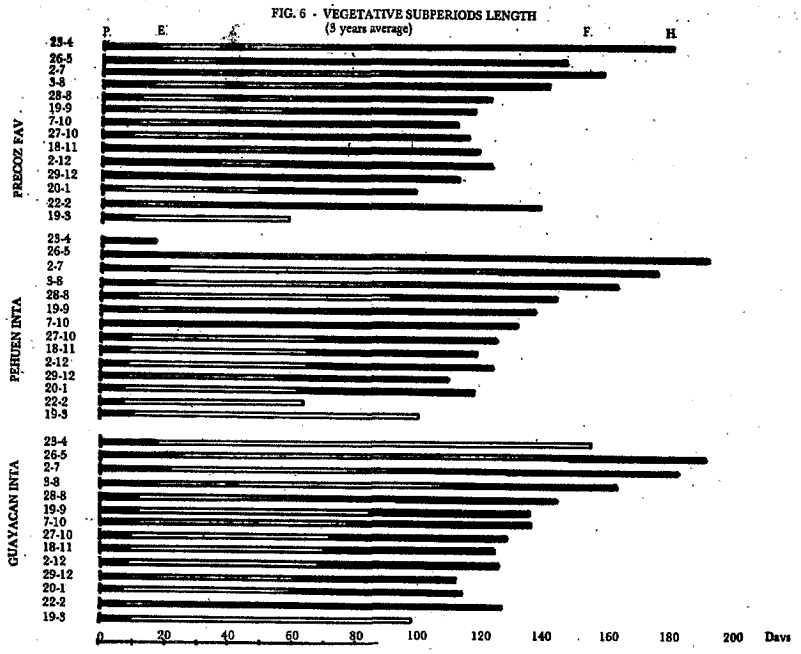

FIG. 8 - DIAMETER OF HEAD AT HARVEST
(5 years average)

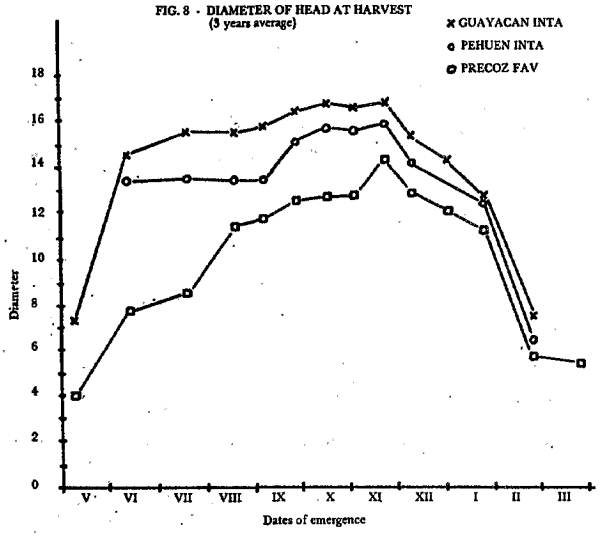

FIG. 9 - WEIGHT OF ACHENES IN THE HEAD
(5 years average)

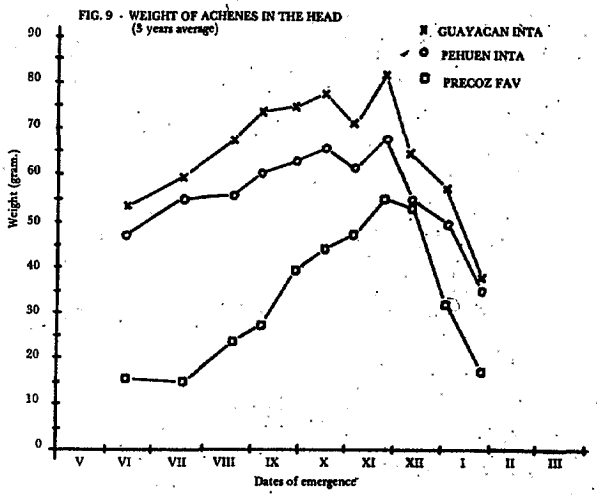

FIG. 10 - NORMAL ACHENES PERCENTAGE
(5 years average)

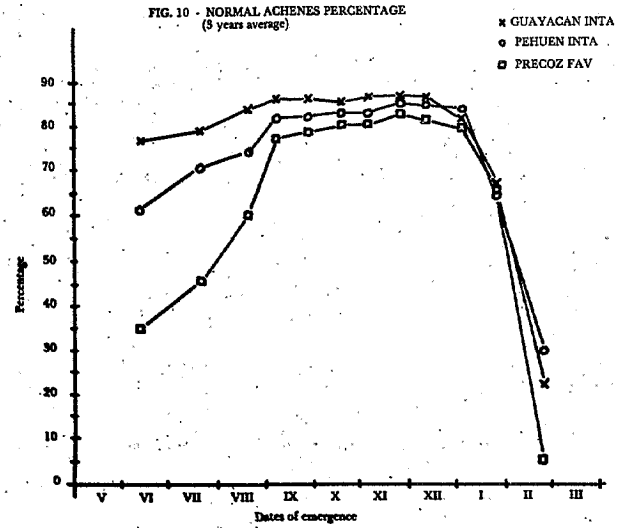

FIG. 11 - OIL CONTENT PERCENTAGE.
(5 years average)

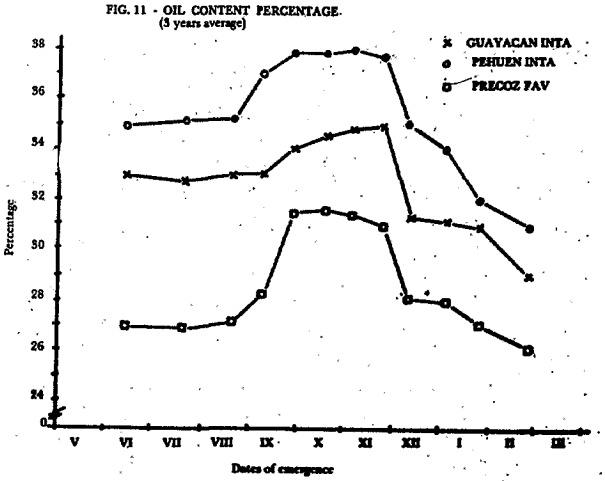

FIG. 1 - PLANTING TO EMERGENCE SUB-PERIOD
(3 varieties and 3 Years average)

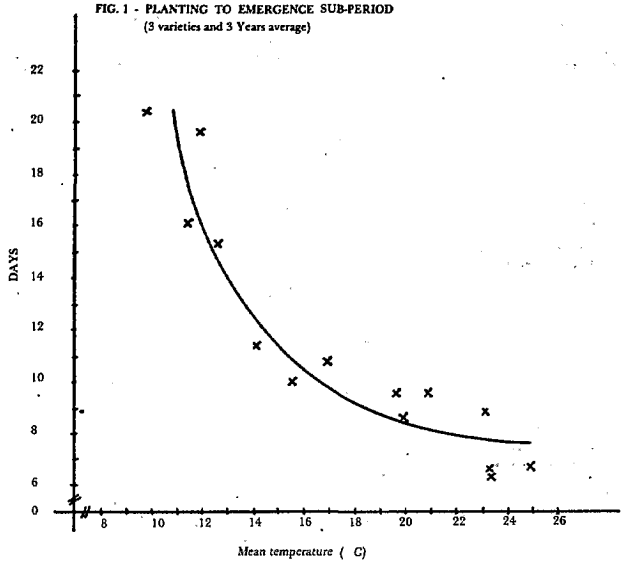

FIG. 2 - DATES OF EMERGENCE - DATES OF BEGINNING OF FLOWERING
(3 years average)

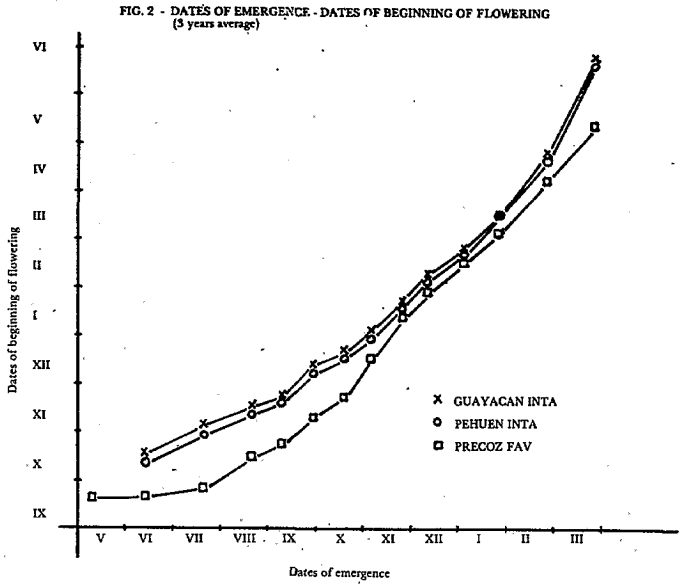

FIG. 3 - DATES OF EMERGENCE - DAYS OF BEGINNING OF FLOWERING
(3 years average)

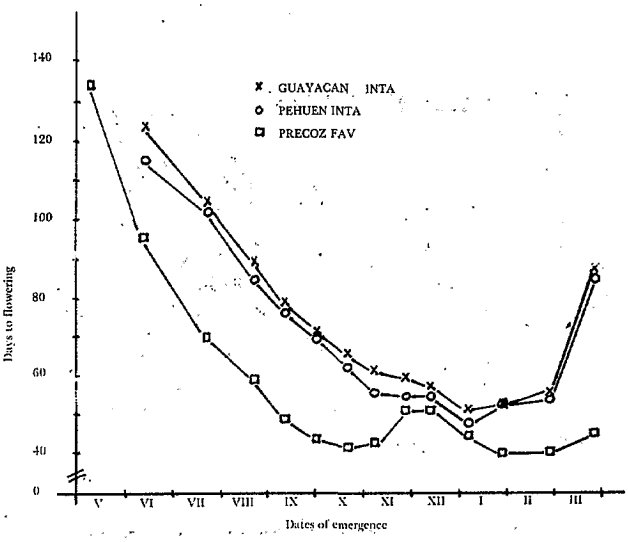

FIG. 4 - DATES OF EMERGENCE - SUMMATION OF TEMPERATURE ABOVE 5°C

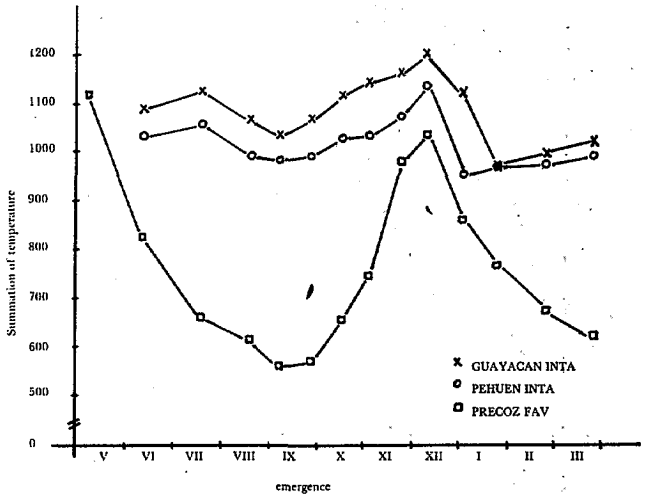

FIG. 5 - MEAN TEMPERATURE FROM EMERGENCE TO FLOWERING - INVERSE OF DAYS TO FLOWERING (3 years average)

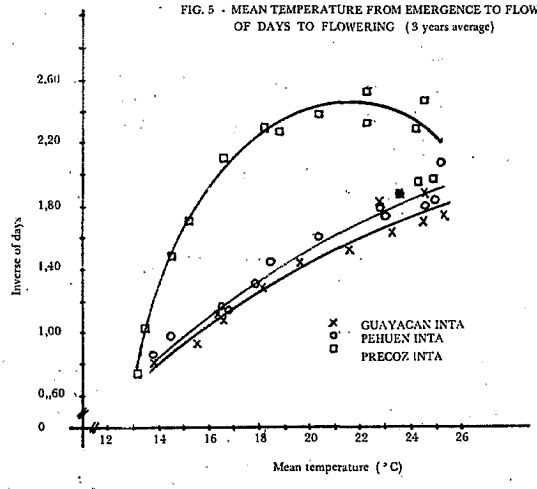

FIG. 7 - PLANTS HEIGHTS AT FULL FLOWERING
(3 years average)