

flower removal and podset on the formation of sclerotia and infection of *Glycine max* by *Macrophomina phaseoli*. *Phytopathology* 59:1243 — 1245.

ZIMMER, D.E. and HOES, J.A. 1978. Diseases. Chapter 7 in CARTER, J.F. (Ed.) *Sunflower science and technology*. Agronomy No. 19 American Society of Agronomy, Crop Science society of America, Soil Science Society of America Inc.

EFFECT OF STAND DENSITY ON THE OCCURRENCE OF CHARCOAL ROT AND OIL YIELD OF SOME SUNFLOWER HYBRIDS.

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ABSTRACT

Yugoslav hybrids NS-H-26 and NS-H-67 were tested for three years to determine the effect of stand density on their seed yield, oil content, and oil yield under conditions in which *Macrophomina phaseoli* Ashby is the principal cause of premature drying up of sunflowers. Changes in stand density did not affect the intensity of occurrence of charcoal rot although it was established that the disease requires a specific combination of air and soil temperatures, rainfall, and condition of host plant. The yields of seed and oil depended on stand density and the meteorological conditions of the test years. The density of 47,000 plants per hectare brought highest yields. The occurrence of perceptible symptoms of charcoal rot at the end of sunflower vegetation did not bring conspicuous yield reductions in the test years.

INTRODUCTION

Sunflower hybrids replaced the varieties VNIMK 8931 and Peredovic in the commercial production in Yugoslavia. The work on the development of hybrids included also agrotechnical studies aimed at the maximum adaptation of environment to the biological requirements of the hybrids. Stand density was an important factor. The majority of the new hybrids favored thicker stands.

Complex interactions exist among plants in thick stands — competition for soil water and nutrients (Diakov, 1976; Ostrovsky, 1976), effect of the above-ground plant parts on the formation of a specific phytoclimate in the crop (Vrebalov, 1966; Stanojevic, 1981).

This study was undertaken to establish the effect of stand density on seed and oil yields in conditions in which

Macrophomina phaseoli Ashby is the principal cause of premature drying up of sunflowers.

MATERIALS AND METHODS

Experiments were conducted at the experimental field in Zajecar during the period 1977 — 1979. NS-H-26 and NS-H-67 were planted in a field in which sunflower had not been grown before, at the densities of 36,000, 47,000, 57,000 and 67,000 plants per ha, applying conventional cultural practices.

The experiment was conducted after the method of random block in five replications. Rainfall and temperature data were collected in the course of the vegetative seasons. During the stage of oil synthesis, soil moisture decreases below lentocapillary limit were registered for the soil layer to a depth of 100 cm. The percentage of infected plants was determined at maturity. NMR method was used for oil content determinations. The results were statistically calculated.

RESULTS AND DISCUSSION

The stand densities examined did not affect the intensity of occurrence of charcoal rot. There were no increases in the intensity of the disease in the plots with thicker stands. The differences obtained in individual years were not statistically significant.

In contrast, there were large differences in the percentage of infected plants from year to year. The lowest percentage was found in 1977, the highest in 1979. The plots had similar percentages in 1978 and 1979, significantly higher than in 1977 (Table 1).

Table 1. Effect of stand density on the percentage of plants infected by charcoal rot.

| Stand Pl./ha | NS-H-26 | | | | | | NS-H-67 | | | | | |
|-----------------|---------|------|------|---------|------|------|---------|-------|------|---------|------|---|
| | Year | | | Average | | | Year | | | Average | | |
| | 1977 | 1978 | 1979 | % | 1977 | 1978 | 1979 | % | 1977 | 1978 | 1979 | % |
| 67,000 | 15.1 | 63.9 | 81.8 | 50.2 | 33.6 | 37.6 | 69.8 | 47.0 | | | | |
| 57,000 | 17.2 | 75.4 | 80.4 | 57.7 | 34.3 | 39.8 | 59.4 | 44.5 | | | | |
| 47,000 | 22.3 | 72.3 | 72.0 | 55.5 | 36.4 | 54.2 | 69.9 | 53.3 | | | | |
| 36,000 | 13.5 | 76.4 | 69.8 | 56.6 | 41.7 | 50.3 | 55.8 | 54.3 | | | | |
| Average: | 17.0 | 72.0 | 76.0 | 55.0 | 36.5 | 45.4 | 63.7 | 48.5 | | | | |
| LSD 5% | | | | 10.64 | | | | 11.92 | | | | |
| 1% | | | | 14.09 | | | | 15.42 | | | | |

A detailed analysis of the meteorological data of the test years showed that the disease required for its occurrence a specific combination of air and soil temperatures, rainfall, and condition of host plant. A low percentage of infected plants in 1977 may be explained by the favorable conditions for plant development. In the period from flowering to physiological maturity the mean daily temperatures ranged from 14 to 24°C. Maximum temperatures did not exceed 33°C. The rainfall for the vegetative season was 394 mm.

The second year had favorable air temperatures but a long period of drought which lasted from budding to physiological maturity. The rainfall, 262 mm, was unfavorably distributed. The drought caused a shortage of readily available water in

the soil layer up to a depth of 100 cm which reduced the vitality of plants and the occurrence of charcoal rot.

The third year had unfavorable air temperatures. Unusually high mean daily and maximum temperatures occurred in early August — over 25 and 35°C, respectively. At the same time, minimum temperatures were below 16°C. The rainfall was 370 mm. A high percentage of infected plants may be explained as the consequence of high temperatures which caused some physiological disturbances in plants.

Seed and oil yield.

Seed yields of both hybrids varied in dependence of stand density and year of growing. The plots with 47,000 plants per hectare produced significantly highest yields (Table 2).

Table 2. Effect of stand density on seed yield (kg/ha).

| Stand Pl./ha | NS-H-26 | | | NS-H-67 | | | Average |
|--------------|--------------|-------|-------|--------------|-------|-------|---------|
| | Year 1977 | 1978 | 1979 | Year 1977 | 1978 | 1979 | |
| 67,000 | 3,719 | 2,289 | 2,423 | 2,810 | 3,962 | 3,272 | 3,145 |
| 57,000 | 3,694 | 3,055 | 2,651 | 3,133 | 4,527 | 3,584 | 3,111 |
| 47,000 | 4,184 | 2,642 | 2,960 | 3,262 | 4,627 | 3,729 | 3,824 |
| 36,000 | 3,271 | 2,464 | 2,546 | 2,760 | 4,136 | 3,451 | 3,739 |
| Average: | 3,717 | 2,612 | 2,645 | 2,991 | 4,313 | 3,509 | 3,455 |
| LSD 5% | | | | 137 | | | 3,759 |
| 1% | | | | 182 | | | 138 |
| | | | | | | | 183 |

Regarding the year of growing, highest seed yields and the lowest percentage of plants infected by charcoal rot were obtained in 1977.

Oil contents varied in dependence of stand density and

climatic conditions (Table 3). The increase in plant number per hectare increased the percentage of oil, especially with NS-H-26 which had highly significant 2.69% more oil in the thickest stand.

Table 3. Effect of stand density on oil content (%).

| Stand Pl./ha | NS-H-26 | | | NS-H-67 | | | Average |
|--------------|--------------|-------|-------|--------------|-------|-------|---------|
| | Year 1977 | 1978 | 1979 | Year 1977 | 1978 | 1979 | |
| 67,000 | 46.91 | 49.35 | 49.97 | 48.74 | 45.64 | 49.42 | 44.47 |
| 57,000 | 46.16 | 48.70 | 46.88 | 47.24 | 44.22 | 49.39 | 44.76 |
| 47,000 | 45.25 | 48.84 | 46.55 | 46.88 | 45.69 | 49.75 | 45.36 |
| 36,000 | 43.76 | 47.54 | 46.85 | 46.05 | 43.31 | 49.47 | 44.56 |
| Average: | 45.52 | 48.61 | 47.56 | 47.23 | 44.72 | 49.47 | 44.56 |
| LSD 5% | | | | 0.85 | | | 45.78 |
| 1% | | | | 1.11 | | | 0.62 |
| | | | | | | | 0.82 |

Oil contents varied significantly from year to year. The average content was lowest in 1977 and highest in 1978 which is an indication that the intensity of charcoal rot occurrence did not affect oil content.

Oil yields behaved similarly to seed yields (Table 4). The plots with 47,000 plants per hectare produced maximum oil yields in 1977 and were significantly higher and positively correlated with the least intensive occurrence of charcoal rot.

Table 4. Effect of stand density on oil yield (kg/ha).

| Stand Pl./ha | NS-H-26 | | | NS-H-67 | | | Average |
|--------------|--------------|-------|-------|--------------|-------|-------|---------|
| | Year 1977 | 1978 | 1979 | Year 1977 | 1978 | 1979 | |
| 67,000 | 1,517 | 983 | 990 | 1,163 | 1,575 | 1,375 | 1,216 |
| 57,000 | 1,484 | 1,292 | 1,081 | 1,286 | 1,742 | 1,539 | 1,207 |
| 47,000 | 1,651 | 1,122 | 1,201 | 1,325 | 1,839 | 1,550 | 1,509 |
| 36,000 | 1,244 | 1,081 | 1,038 | 1,100 | 1,558 | 1,485 | 1,449 |
| Average: | 1,474 | 1,103 | 1,077 | 1,218 | 1,678 | 1,487 | 1,345 |
| LSD 5% | | | | 66 | | | 1,503 |
| 1% | | | | 87 | | | 74 |
| | | | | | | | 99 |

CONCLUSION

Changes in stand density did not affect the intensity of occurrence of charcoal rot on sunflower hybrids NS-H-67 and NS-H-26.

The occurrence of the disease was related to dry conditions and the shortage of readily available soil water at the stages of

intensive plant growth and oil synthesis.

The intensive occurrences of the disease before harvest did not adversely affect the percentage of oil.

Oil yields and contents depended on stand density and meteorological conditions. Highest seed and oil yields were obtained with 47,000 plants per hectare.

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METHODS OF STUDYING THE REACTION OF SOME CULTIVARS AND WILD SPECIES OF SUNFLOWER TO INFECTION BY *SCLEROTINIA SCLEROTIORUM*.

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ABSTRACT

The work carried out at the Experimental Station of C.E.T.I.O.M. in Saint-Pathus was aimed at studying semi-artificial inoculation of sunflower and cultivar response to inoculation, with *Sclerotinia sclerotiorum*. The trial was carried out in the field, partially under a roof. The results showed that *S. sclerotiorum* developed more slowly on two cultivars, 9SC-69(4) and Stepniak 1-2, than on all other cultivars tested. Rates of disease development differed, depending on which inoculation technique was used. The two techniques which produced different rates of disease development were: (1) a spore suspension of 40 ascospores mm⁻³ and; (2) wet confetti with 20 to 50 ascospores placed between the bracts and tubular flowers. We concluded that there were differences in the rate of disease development in sunflower heads which could not be related to resistance or tolerance.

SUMMARY (in French)

Les orientations du travail du Centre expérimental du C.E.T.I.O.M. à Saint-Pathus ont porté sur l'étude de la contamination semi-artificielle du Tournesol et la réponse des cultivars à cette inoculation. L'essai se déroule au champ, en partie sous un toit.

Des résultats on tire que: deux cultivars 9SC69(4) et Stepniak 1-2 présentent des taux d'attaque moins

MATERIALS AND METHODS

The following lines, cultivars and species were used:

| Source | Line | Code Used in Tables |
|--|--|--------------------------------------|
| I.N.R.A. Clermont-Ferrand (Mr Leclercq) | 9SC-69(4) 9SC-28(4) GHP 9SC-10(3) 9SC-2(7) PAC 1 GAHIB 7 apavonal 1980 GAHIB 12 apavonal 1980 | 1 2 3 4 5 6 7 8 |
| Hungary | | |
| I.N.R.A. Montpellier (Mr Tersac) (Mr Piquemal) (Mr Serieys) | H9P3 STEPNIAK 1-2 9SC120-2 | 9 10 11 |
| I.N.R.A. Montpellier Wild Species (Mr Serieys) | <i>H. rigidus</i> x <i>H. annuus</i> C G 60sib | 18 |

élevés que tous les autres; un accroissement relatif des taux d'attaque variable selon les formes est observé pour les plantes inoculées par rapport aux plantes témoins non inoculées (mais placées en zone polluée); les deux techniques permettant ces accroissements sont une suspension de spores à concentration de 40 ascospores par mm³ d'une part, et des confetti humides porteurs de 20 à 50 ascospores, disposés entre les bractées des fleurs tubulées fleuries d'autre part.

Sur ce chapitre on conclut à des différences de taux d'expression des symptômes, ce qui ne rend pas compte de la résistance ou de la tolérance, celle-ci ne pouvant être dégagée que par comparaison sur plusieurs années.

INTRODUCTION

C.E.T.I.O.M. and I.N.R.A. have been studying possible ways of controlling *Sclerotinia* in sunflower. Among them, cultivar resistance and tolerance were studied in detail (Pierre and Regnault, 1978, 1979). We know that the normally grown cultivars do not seem to have any resistance to the disease, but disease development depends on climatic conditions and consequently varies in different years and localities. Hence, it was important to study the response of lines, hybrids, parental lines, foreign varieties and a wild species to different methods of inoculation with *S. sclerotiorum* under fairly uniform conditions.