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FURTHER INVESTIGATIONS OF WINTER FROST DAMAGES ON HAZELNUT PLANTS IN NORTHERN ITALY

In the Monferrato (Alessandria) hazelnut cultivation area, in the first half of February 2012 a strong drop of temperature occurred. The effect of these very low temperatures was a bark vertical cracking on the single trunk of hazelnut trees and it was investigated in three (A, B and C) different hazelnut orchards. The absolute minimum temperature recorded was $-22,40^{\circ}\text{C}$ in two orchards and $-16,40^{\circ}\text{C}$ in another one. The damages intensity was estimated considering the cracks length and the width. So we obtained a damages score as follow: none, low, medium, severe and very severe. The general average of damaged trees vary from the minimum of 40,56 for orchard C, till a maximum of 69,57% for orchard B. This data seems to be related to the minimum absolute temperature values reached in each of the three considered orchards. The effects of absolute minimum temperatures, soil conditions, proximity to a stream and altitude of the plot of land were considered.

Introduction

In the 1st half of February 2012 a strong drop in temperatures occurred in hazelnut growing area of Monferrato district in the province of Alessandria. This climatic situation caused negative effects on hazelnut plants. In our previous work (Roversi, Pansecchi, in press) these negative effects were detected with special regards to the value and the frequency of bark vertical cracking on the single trunk of hazelnut plants.

Materials and Methodology

The investigations were carried out in three different locations recording for each orchard the damages using a score from 0 (undamaged) to 4 (very severe).

The plant position in each orchard show an effect on the damages emphasizing their intensity and frequency in the lower part of the orchards. The general damages percentage was related to the values of the minimum absolute temperature.

In this second work, the results of not yet published investigations are shown for three new hazelnut orchards in the same area.

Follow a short description of these three orchards:

A.: This orchard is 6 years old, grown on grassed soil, with 4×5 meters spacing and single trunk trained. For this investigation we have considered 12 rows 47 plants each. These rows run along a stream that

flows in a valley bottom at a distance variable from it between 5 to 60 meters. We have considered “near” the 3 rows in proximity to the stream and “far” the 3 farthest ones.

B.: The second orchard is located in a plot of land adjacent but at a higher altitude than the first one. The plants, 6 years old, are grown on a grassed soil, with a 4×5 meters spacing, and single trunk trained. The rows of 40 plants each are orthogonal to the rows of the previous orchard. In this orchard it's clearly observable a strip of “heavier” soil that cross the plot and interest crossways at least 12 rows.

The plants grown in this strip, sometimes, in spring, after rainy winters, show anoxia symptoms that disappear during the following months. This kind of soil in the table and in the text will be named “bad”, while the remaining soil will be named “good”.

C.: The last orchard is 7 years old, grown on grassed soil, with 4×5 meters spacing and single trunk trained. There are 50 rows of 45 plants each; the rows follow the maximum slope with a difference in altitude of 60 meters.

As in the previous cases, the damages valuation, regarded the intensity and the frequency of bark vertical cracks. Obviously the data were recorded separately for plants in lower and higher parts of the orchard.

Observations and recording

For each considered orchard, the damages frequency and their intensity was recorded. The overall data were shared following the different variables studied for each hazelnut orchard as shown in the tables.

The damage intensity was evaluated following the same score of the previous work:

- N = None
- L = Little
- M = Medium
- S = Severe
- V = Very severe

The data statistical analysis has been made by “t” test and Tukey test for multiple comparisons.

Climatic data

The climatic trend, in the period 1–15 February 2012 were checked from the RAM (Rete agrometeorologica della Regione Piemonte) recording of the weather stations nearest to the orchard.

These stations were the ones of Cuccaro for orchard C and Quargnento for the A and B orchards.

Results and discussion

1. Climatic trend:

— The results of Cuccaro climatic station show an average of minimum temperature of $-8,98$ with a minimum absolute of $-16,4^{\circ}\text{C}$. The number of days with temperature lesser than the average was of 7 days. The days of very low temperature were from 5 to 7 and from 12 to 14 February.

— The absolute minimum temperature recorded from the Quargnento weather station, was $-16,40^{\circ}\text{C}$, with two periods of low temperature from 3 to 7 and from 12 to 15 of the month. The number of days with temperature lesser than the average was of 10 days.

2. Damages:

— Orchard A

In this orchard, where the absolute minimum temperature (table 1) was of $-22,4^{\circ}\text{C}$, the general average of damaged plants (figure 1) was of 48,02%.

The data show clearly the strong effect of rows proximity to the stream on the damaged plants percentages. In fact the damages average of the plants in the rows near the stream results (table 2) of 16.40% versus 7.71% observed for the plants in the rows very far from the small river. The differences observed (figure 2) between the damages occurred to the plants near or far from the stream are significant only for *Severe* and *Very severe* scores.

— Orchard B

In the second hazelnut orchard of this location the general average of damaged plants was of 69,54% even if the temperatures were the same of the previous orchard. In the orchard B we have 2 different soil quality in the same plot of land.

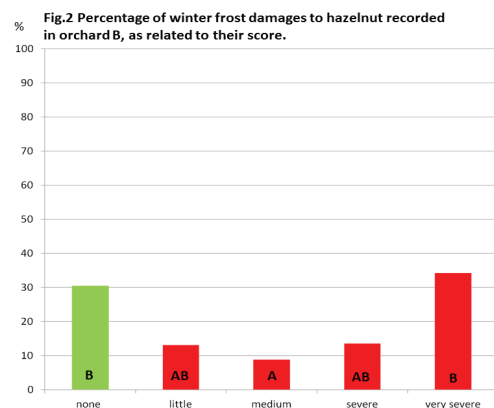
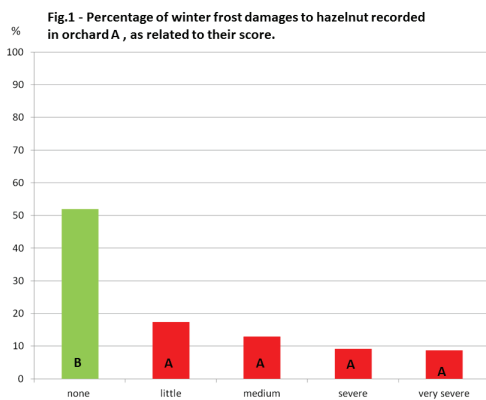
As previously observed, one of them is a clay soil as usual in this district. In the middle of the same plot there is a strip, interesting at least 12–13 rows, in which, at the end of winter, roots anoxia symptoms were observed.

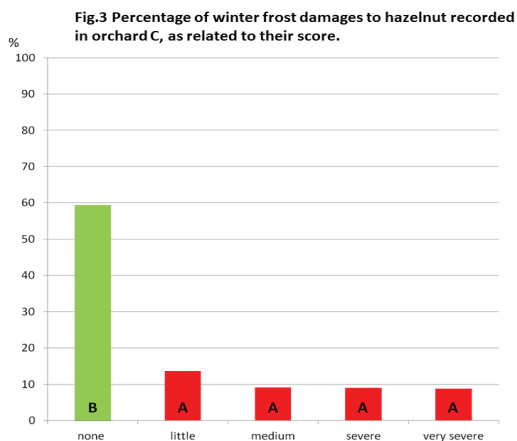
During the check of plant damages data were recorded in 9 rows for this bad area, separately from the data of the others rows in good soil.

The data of table 3, show the negative effect of bad soil quality on the winter frost damages especially for the *Severe* and *Very severe* damage categories. For both categories, the difference between recorded damages on the plants in good or bad soil, are highly significant.

— Orchard C

In this orchard, where the absolute minimum temperature (see table 1) was of $-16,4^{\circ}\text{C}$, the general average of damaged plants (figure 3) was of 40,56%.





A very strong influence was due to the plant position in the rows. In fact the average percentage of damaged plants was of 17,77% for the ones located in the lower part of the rows, and only 2,61% for the plants located in higher part. In any case, in the higher parts of the rows, the 89,57% of plants weren't damaged, and the plants with very severe damages were only 0,76%. This situation was similar to the one observed in our previous work (Roversi, Pansecchi, *in press*)

3. General considerations:

The general damages, observed on the plants of orchard B (69,57%), was noticeably and significantly higher than the ones observed in orchards A (48,02%) and C (40,56%).

As expected the maximum damage percentage (69,57%), was observed in Orchard A in the area, where the minimum absolute temperature (-22.4°C) was reached. In the same location 10 meters far from Orchard A, the maximum damage percentage was of 55,56% for the plants in Orchard B, grown in bad soil.

In Orchard A, the percentage of plants far from the stream (7,61%) was similar to the one (9,77%) observed for the plants grown in good soil in Orchard B. On the contrary the average damage percentage was observed both in Orchard A near the stream (16,40%) and in Orchard B in bad soil (25,00%).

Conclusion

The results of this investigation and of the previous one (Roversi, Pansecchi, *in press*) can be useful for the hazelnut growers in view of future plantations. In fact, the highest damages to the hazelnut plants were especially observed in the orchards situated in the lower parts of the plot in hill, near the stream in plain and where the climatic conditions are associated to soil

structure problems. So in these situations, new hazelnut orchards plantation are strongly not recommended.

References

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УШКОДЖЕННЯ РОСЛИН ФУНДУКУ ЗИМОВИМИ МОРОЗАМИ НА ПІВНОЧІ ІТАЛІЇ

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На початку лютого 2012 року на території вирощування фундуку в Монфератто (Алессандрія) спостерігалось стійке зниження температури, яке зумовило пошкодження рослин. У трьох садах (А, В, С), що відрізнялися за ґрунтовими умовами і висотою території над рівнем моря, досліджували інтенсивність пошкоджень дерев фундуку. У двох садах (А і В) абсолютний мінімум температури повітря опустився до $-22,40^{\circ}\text{C}$, тоді як у третьому саду (С) мінімальна температура склала $-16,40^{\circ}\text{C}$. Пошкодження оцінювали за кількістю дерев з вертикальними тріщинами на стовбурах, розмірами і глибиною тріщин. Найменше число пошкоджених дерев було в саду С (в середньому 40,56%), при максимальній їх кількості в саду В (69,57%). Ці дані відповідають температурним показникам абсолютного мінімуму вивчених ділянок. Розглянуто ефекти абсолютних мінімальних температур, ґрунтових умов, відстані дерев від річки, що протікає по дну долини, а також висоти території над рівнем моря.

ПОВРЕЖДЕНИЯ РАСТЕНИЙ ФУНДУКА ЗИМНИМИ МОРОЗАМИ НА СЕВЕРЕ ИТАЛИИ

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В начале февраля 2012 года на территории выращивания фундука в Монфератто (Алессандрия) наблюдалось устойчивое понижение температуры, вызвавшее повреждение растений. В трёх садах (А, В, С), отличающихся по почвенным условиям и высоте территории над уровнем моря, исследовали интенсивность повреждений деревьев фундука. В двух садах (А и В) абсолютный минимум температуры воздуха опустился до $-22,40^{\circ}\text{C}$, тогда как в третьем саду (С) минимальная температура составила $-16,40^{\circ}\text{C}$. Повреждение оценивали по числу деревьев с вертикальными трещинами на стволах, размерам и глубине трещин. Наименьшее число повреждённых деревьев было в саду С (в среднем 40,56%), при до максимальном их количестве в саду В (69,57%). Эти данные соответствуют температурных показателям абсолютного минимума изученных участков. Рассмотрены эффекты абсолютных минимальных температур, почвенных условий, расстояния деревьев от протекающей по долине речки, а также высоты территории над уровнем моря.