International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 05 May 2024, pp: 486-492 www.ijaem.net ISSN: 2395-5252

Method for Unambiguously Determining the Location of an Observed Area of 1m^2 in Fruit Plantation

Hristian Kosev[1], Ivan Zahariev[2*]

[1]*Student, Agricultural University - Plovdiv, 12 Mendeleev Blvd, Department of "Mechanization of agriculture", Plovdiv, Bulgaria.*

[2]*Cheif Assistant Professor, Agricultural University - Plovdiv, 12 Mendeleev Blvd, Department of "Mechanization of agriculture", Plovdiv, Bulgaria.*

Date of Submission: 10-05-2024 Date of Acceptance: 20-05-2024

ABSTRACT: The article presents the attempts made in a plum orchard to determine the exact location of a controlled area, before and after the passage of a tillage machine. It is proven that with the proposed method it is possible to determine the exact location of the selected observation area at any time and after any processing. An economic assessment of the cost of the materials used was made. The method can be used in any areas. Does not require GPS network coverage. The cost of the materials used is $9.97.

KEYWORDS: Permanent crops, orchards, method of measurement, unity of results

I. INTRODUCTION

Since the dawn of mankind, there have been various methods and means of determining the locations of an object. As technology advances, these tools become more and more accurate and precise, with satellite communication and an increased level of reporting of location coordinates.

According to Kienzle et al(2013), Marangoni Junior, & da Costa Ferreira (2019). even small farms need mechanization not only to maintain the viability of their activities despite limited labor availability, but also to increase their production capacity and efficiency[1, 2].

With the introduction of GIS (Geographic Information System) and GPS (Global Positioning System) technologies in the mechanization of agriculture, a new branch began to develop - precision agriculture. The main premise of precision agriculture is a greater amount of information as well as more accurate information available to the farmer when making decisions [3, 4].

The modern world is full of electronic devices. GPS coordinates are used to determine the exact location of a given area. For now, only military devices provide the necessary accuracy for the needs of precise scientific research, but access to them is very limited. Civil devices for mass use do not give satisfactory results and require a minimum amount of knowledge from their user. Their operation requires a source of electrical energy and charging of their battery. In addition, the monitoring system costs a hefty sum that few farmers can afford yet.

Existing determination methods require special tools that are rare and not readily available.

From the foregoing, it is clear that a method is needed to accurately determine the location of a monitored area using inexpensive and widely available measuring devices.

II. MATERIALS AND METHODS

The spatial orientation of the orchard is determined using a compass. The intra-row and inter-row distance between individual trees is measured. The orchard is walked around to collect data for further research and 5 locations are determined at random. In some types of research, other factors specific to the research itself are taken into account when determining the location.

Two adjacent trees (one from each row in the interrow) are determined at the selected location of the observed interrow. Take a paper tape, a blue pen and a folding knife. Cut 2 pieces of 120 mm long from the paper tape and glue them to the branches of the selected trees in the following sequence:

The operator takes the previously prepared piece of tape and holds it at both ends with the adhesive side down. It bends it into a shape

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 05 May 2024, pp: 486-492 www.ijaem.net ISSN: 2395-5252

resembling the Greek letter omega (Ω). This way, gluing it around the selected branch will result in a rectangular area for writing the number, hanging vertically down. In addition, the two ends of the piece of tape with their smeared side will come together and the adhesion will be strong. The size of the rectangular area formed after wrapping around the branch depends on the size of the branch at the point of gluing.

He stands with his back to the geographical direction south in the interrow, between the selected trees. On the selected tree standing next to his right shoulder, the prepared piece of tape is stuck to the left standing branch against the trunk of the tree, pointing to the other selected tree on the opposite row. On the left tree, stick the second piece of tape on the right-standing branch relative to the trunk of the tree and pointing to the first tree in the right row. With the help of a blue chemical, write the consecutive number (the same for both pieces of sticky tape) corresponding to the number of the examined area. The inscription should be oriented to the south.

In this way, the spacing can be determined even if one of the two pieces of tape has fallen. The operator only needs to stand in front of the marked tree facing north and look at the location of the branch with the marker relative to the tree trunk. The branch points to the opposite row with the closest tree.

A polyethylene rope with a diameter of φ4 mm is taken. It is wrapped around the trunk of the left tree twice and tied at field height. It stretches to the right tree. It is wrapped around the trunk of the tree twice at the same height and tied. Care is taken not to injure the bark of the trees. The rest of the rope is positioned to the right of the right tree.

Measure the circumference of the left tree and determine its radius by the dependency:

$$r = \frac{c_0}{2.\pi} \qquad (1)$$

where: c0 – circumference of the left tree at the first measurement.

Four measuring tapes are used: one 5-meter and three 3-meter (Fig. 1).

Attach the L-shaped magnet end of the 5-meter tape measure to the rope loop around the trunk of the left tree. The tape measure is stretched to the right to 3.5 m and placed horizontally on the taut rope. Another three 3-meter measuring tapes are taken.

Figure1: Measuring tapes 3, 5 and 8 m long [5]

The first 3-meter tape measure is attached to the 5-meter tape measure perpendicularly so that the right side of its tape rests at the 2 m reading on the tape of the 5-meter tape measure.

The second 3-meter tape measure is attached to the 5-meter tape measure perpendicularly so that the left side of its tape rests at the 3 m reading on the tape of the 5-meter tape measure.

Measure the thickness of the tape on the five-meter tape measure.

The third 3-meter tape measure is attached perpendicular to the first - meter tape measure so that the right side of its tape lies at a reading of 1 m plus the tape width of the 5-meter tape measure. It is stretched parallel to the 5-meter measuring tape for a length of 1.5 m crossing perpendicularly the second 3-meter measuring tape of the same reading (1 m plus the tape width of the 3-meter measuring tape).

The right angle is controlled using a 90 degree protractor (Fig.2).

Figure 2: Angle measure for right angle 90^0 [6]

By observing the order of the procedures in the manner described above, an area of 1 m^2 is outlined (Fig. 3).

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 05 May 2024, pp: 486-492 www.ijaem.net ISSN: 2395-5252

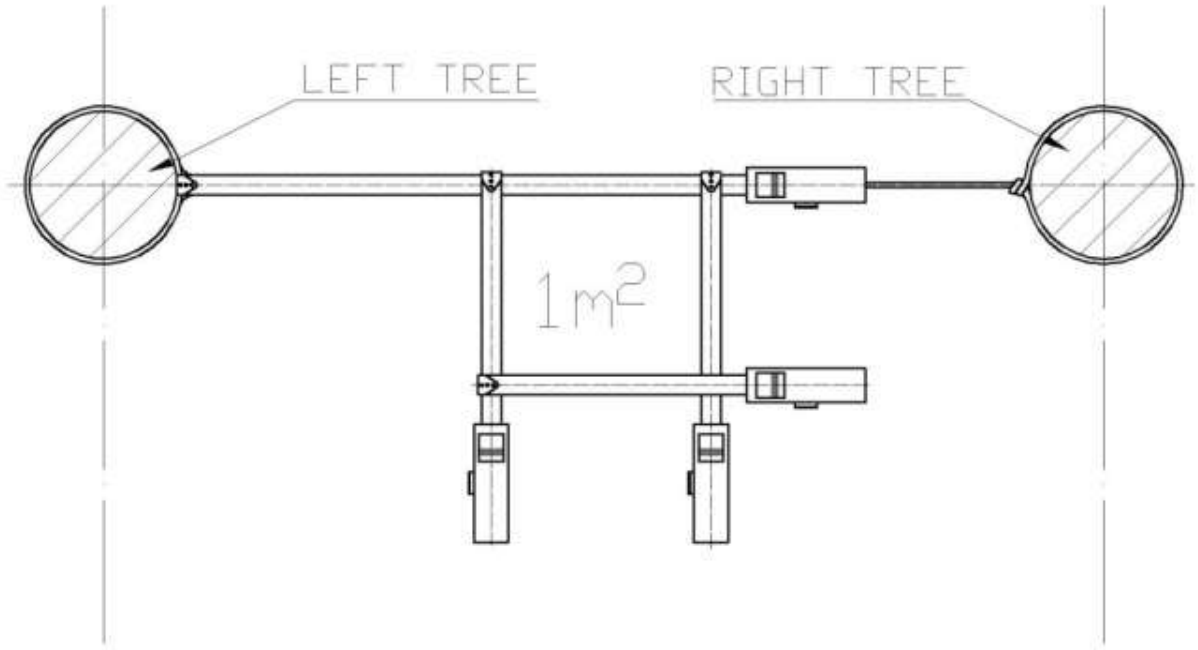

Figure 3: Layout of the measuring devices

If necessary, pegs are driven into the four corners of the square shape and a thread is stretched around them. Carefully work so as not to displace the adjusted measuring tapes.

For the rest of the observed areas, the same sequence is followed when marking the trees and determining the location of the 1 m^2 area.

If a different location of the observed area in the row is needed, it is only necessary to move the 3 3-meter measuring tapes and recalculate the positions of their magnetic ends on the 5-meter measuring tape. A mirror arrangement with respect to the taut rope is possible.

In the absence of one or two 3-meter measuring tapes, it is possible to replace them with the widespread wooden measure of length of 1 m or 2 m (Fig. 4.).

Figure 4: Wooden length measure[7]

The marking tools are retracted in the following sequence.

- Disconnecting the measuring tapes;
- The stop buttons of the measuring tapes are released. The strips retract independently under the action of the built-in spring. Care must be taken not to injure the operator;
- Untying and winding the polyethylene rope.

At each subsequent measurement, first start by determining the radius of the left tree according to dependence 1 and calculating the growth of the tree trunk z, mm:

$$z = r_i - r_0 \qquad (2)$$

where: r_0 – the calculated radius at the first measurement;r_i – the calculated radius at the ith measurement.

To determine the exact location of the observed area, the first and second 3-meter measuring tapes are shifted to the left by the calculated value of the growth of the tree trunk z, mm.

Economic evaluation of the cost of the materials used

Five stores for building materials are visited and the prices of:

- Measuring tape 3-meter;
- Measuring tape 5-meter;
- Angle measure for right angle 90^0 350 x 160
- Polyethylene rope φ4 with a length of 10 m.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 05 May 2024, pp: 486-492 www.ijaem.net ISSN: 2395-5252

The average value $\bar{x}$is calculated according to the formula, BGN:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}, \qquad (3)$$

where: x_i – the purchase price of the requested product in the ith store, BGN/pcs;n – the number of inspected stores for construction materials, pcs.
The cost of the materials used is calculated according to the formula:

$$\bar{X} = 3 \,.\, \bar{x}_1 + \bar{x}_2 + \bar{x}_3 + \bar{x}_4 \qquad (4)$$

where:$\bar{x}_1$– the average value of the purchase price of a 3-meter measuring tape, BGN/pcs;$\bar{x}_2$ - the average value of the purchase price of a 5-meter measuring tape, BGN/pcs;$\bar{x}_3$ - the average value of the purchase price of Angle measure for a right angle 90^0 350 x 160, BGN/pcs;$\bar{x}_4$ - the average value of the purchase price of polyethylene rope φ4 with a length of 10 m, BGN/pcs.

III. RESULTSANDANALYSIS

Attempts to study the method of unambiguously determining the location of an observed area of $1m^2$ in fruit plantations were carried out in two stages.

The first stage was in the corridor of department of "Mechanization of agriculture" of the Agricultural University - Plovdiv. Trial testing is illustrated with the photographic material:

Figure 5: Location of measuring devices

Figure 6: North left corner

Figure 6: North right corner

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 05 May 2024, pp: 486-492 www.ijaem.net ISSN: 2395-5252

Figure 8: South left corner

Figure 9: South right corner

From the photos in figures 5 to 9, it can be seen that by using the measuring tools, an area of 1 m^2 can be determined regardless of the terrain conditions.

The second stage was carried out in a permanent plantation of prunes located in Rakovski municipality, Plovdiv region. Due to the absence of the 3rd 3-meter tape measure at the time of measurement, a wooden length measure was used.

Figure 10: Left tree number 4

Figure 11: Right tree number 4

Figure 12: Outlined area number 4 before the passage of a tillage machine (disc harrow)

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 05 May 2024, pp: 486-492 www.ijaem.net ISSN: 2395-5252

Figure 13: Passing a tractor with a disc harrow

Figure 14: Outlined area number 4 after passing a disc harrow

The pictures (Fig.10 to Fig.14) show the effectiveness of the method for determining the location of the observed area regardless of its processing and the time frame of the measurement.

Economic evaluation of the cost of the materials used

To determine the purchase price of the 4 materials used, the 5 largest stores for construction materials in the city of Plovdiv were visited.

The processing of the results was carried out in the "Agricultural Mechanization" department at the Agricultural University - Plovdiv, using the sequence of work described in the MATERIAL AND METHOD section.

– the average value of the purchase price of a 3-meter tape measure, $\bar{x}_1$= 3.19BGN/pcs;

– the average value of the purchase price of a 5-meter tape measure, $\bar{x}_2$= 4.58 BGN/pcs;

– the average value of the purchase price of Angle measure for a right angle 90^0 350 x 160,$\bar{x}_3$ = 14.12BGN/pcs;

– the average value of the purchase price of polyethylene rope φ4 with a length of 10 m, $\bar{x}_4$= 2.70BGN/pcs.

Cost of materials used according to formulas (3) and (4): $\bar{X} = 30.97$ BGN

The distribution of the value of the individual elements in percentages of the total value is visualized in the following figure:

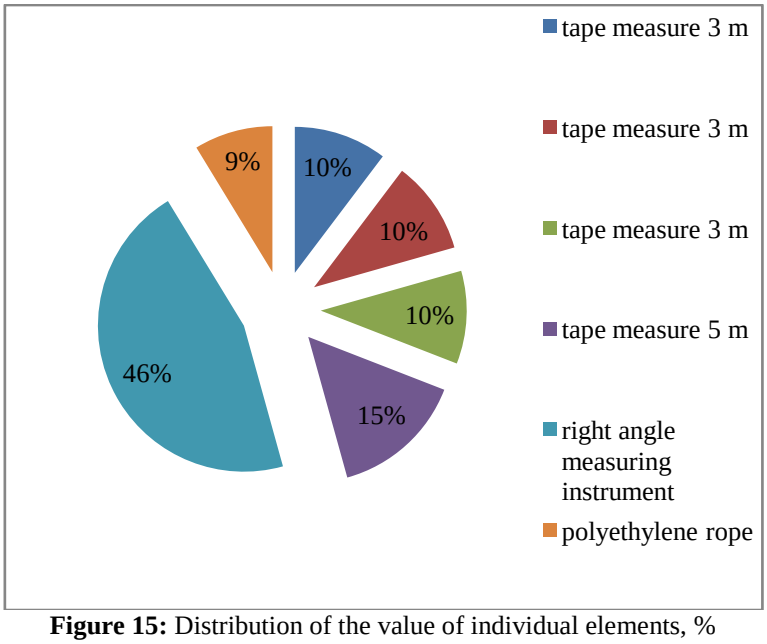

Figure 15: Distribution of the value of individual elements, %

It is noteworthy that the angular measure for a right angle 90^0 350 x 160 occupies 46% of the cost price.

When using a plastic triangle 15 cm 45/45 with a right angle 90^0 with a purchase value of 1.21 BGN/pcs, instead of a metal angle measure for a right angle 90^0, the cost of the materials used will be only $\bar{X}$ = 18.06 BGN or $9.97 (1 BGN = $0.55194 according to the exchange rate of the Bulgarian National Bank for 13.05.2024) [8]

IV. CONCLUSIONS

Based on the above, the following conclusions can be formulated:

1. The proposed method requires affordable and widespread means of measurement. In addition, it is not necessary for the operator working with the measuring devices to have knowledge of foreign languages and computer literacy.
2. It can also be applied to orchards without GPS coverage and to any soil treatments.
3. The cost of the materials used is $9.97.
4. As a disadvantage, it was found that a marker made of a durable material was needed.
5. Writing the number on the marker on the south side, which is lit by the sun, causes it to whiten.

REFERENCES

[1]. Kienzle, J. Ashburner, J.E., Sims, B.G.Mechanization for rural development:A review of patterns and progress. v.20. Rome: FAO, Pages364, 2013;
[2]. Marangoni Junior, A., da Costa Ferreira, M. Influence of working pressure and spray nozzle on the distribution of spray liquid in manual backpack sprayers. Arquivos do Instituto Biológico, 86, e0442018. 2019;
[3]. Gavrić, M. Primjena GIS-a i GPS-a u poljoprivredi, 2004;
[4]. Stević, A. Primjena GIS tehnologije u sustavu precizne poljoprivrede pri sadnji trajnih nasada, Diplomski rad, Faculty of agriculture.(https://repozitorij.fazos.hr/islandora/object/pfos:397/preview), 2014;
[5]. https://www.ems.bg/%D0%BE%D0%BD%D0%BB%D0%B0%D0%B9%D0%BD-%D0%BA%D0%B0%D1%82%D0%B0%D0%BB%D0%BE%D0%B3/%D0%B8%D0%BD%D1%81%D1%82%D1%80%D1%83%D0%BC%D0%B5%D0%BD%D1%82%D0%B8-%D0%B0%D0%BA%D1%81%D0%B5%D1%81%D0%BE%D0%B0%D1%80%D0%B8-%D0%B8-%D0%BA%D0%BE%D0%BD%D1%81%D1%83%D0%BC%D0%B0%D1%82%D0%B8%D0%B2%D0%B8/%D1%80%D0%BE%D0%BB%D0%B5%D1%82%D0%BA%D0%B0-5%D0%BC-%D1%85-25%D0%BC%D0%BC-black-edition-topmaster-professional/ 2024/04/10;
[6]. https://www.topmaster.bg/c/roletki-8/prav-gl-351 2024/04/10;
[7]. https://www.crafttools.bg/bg/izmervatelni-uredi/tolsen-metyr-dyrven-sgyvaem-2-m 2024/04/10;
[8]. https://www.bnb.bg/Statistics/StExternalSector/StExchangeRates/StERForeignCurrencies/index.htm, 2024/05/13.