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Assessing the Impact of Primary Tillage on Soybean

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Introduction

A significant leguminous crop and a vital oilseed is the soybean (Glycine max L.). The so-called "Golden bean" of the twenty-first century is described as soybean. In addition to having a high quantity of amino acids like lysine, it is an outstanding source of both oil and protein. The yield of soybeans might vary depending on the tillage strategy used. This study was done to assess the effects of various tillage methods on soybean development and yield characteristics when using various tillage techniques. This refers to traditional, direct drilling, and loosening tillage techniques. With regard to of its protein content, soybean (*Glycine max (L.*) Merr.) Ranks as one of the important legume crops. The need to provide nutrition for humans, animals, and crops has increased everywhere, particularly in Europe.(Adamič & Leskovšek, 2021).

Over a 4-year period, it was discovered that reduced tillage significantly affected the soybean production and yield components in each of the experimental years. In the different tillage regimes, yields declined in the following order: Conventional tillage for soybean and no tillage for winter wheat> conventional tillage for soybean and disc harrowing for winter wheat>Conventional tillage>Soil loosening (chisel plough)>Conventional tillage for winter wheat and disc harrow for soybean >Disc harrowing (fine till)>Conventional tillage for winter wheat and No tillage for soybean>No tillage. Disk harrowing, chisel ploughing, and disking for soybeans after traditional cultivation for wheat resulted in soybeans of a similar standard and were just slightly better than the management, consequently these techniques could be recommended as suitable substitutes for traditional cultivation. No tilling, whether used on the two crops or just the soybeans, can't be viewed as helping the production of the soybean. (Jug et al., 2010).

The tillage structure, climate, plus innovation specific for each method all have an impact on the production capacity of soybeans. The power and extent of tillage are reduced, which increases weeding operations and broadens the range of weeds. When soil is moved by ploughing, weeding can noticeably reduce, especially for weeds that are perennial. (Cheţan et al., 2022).

Where the best output was discovered, chisel and disk plows provided 10% greater yields of soybeans than no cultivating on winter wheat. In general, despite having improved the aggregate of soil, 37 years of no-tillage, using or lacking reduced cover planting, failed to result in a consistent improvement in the yield of soybeans and soil physical attributes.(Nouri et al., 2018).

Compared to another variety, Aldana produced 10.6% more seeds per plant. Additionally, this variety stood out for having more plants per square foot after germination and before harvest, more seeds per pod, and more than 1000 seed weight. Direct sowing resulted in yields of soybeans that were 14.7% lower than those produced by traditional tillage. Compared to plough ploughing, no-tillage drastically decreased height of plants, early pod length, number of plants after development, and collection time.(Gawęda et al., 2014).

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1.2 Aims of the research

The research was aimed at achieving the following objectives:

- To evaluate the effects of different tillage techniques on soybean grain yield.
- To research and assess the impacts of multiple tillage systems on the physical characteristics of soil state in field conditions, with an emphasis on the agronomic structure of the soil, penetration resistance, and moisture content that affects the yield of soybeans.

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1.3 Purpose of the study

The primary research area was the soybean cultivation method and possible approaches for raising yields in Hungary. Because it has served as both humans' plus livestock' main sources of amino acids as well as oil. Production and yield have not greatly risen over the years, although having enormous implications for the country's economic well-being and availability of food.

2. Literature Review

2.1Back ground of the crop

Soybeans made their way across Asia via Europe plus North America in the seventeenth century. Up till the eighteenth century, after the plant-based dietary movement began to take off, Europe and America continued to be obsessed with a diet centred on meat. Since then, the crop has grown in importance to the local economy(Allaire etal.., 2007).

Although soybeans have been grown in China over numerous years, the crop actually originated in eastern Asia. Based on estimations, around 1700 and 1100 B.C., under the Shang Dynasty, soybean (*Glycine soja)* was domesticated from its natural state. Even though they're not the main growers, China as well as other Asian countries still consume large volumes of both traditional and innovative soy meals. China imported over $3 billion value of entire soybeans compared to the US in 2018, making it the world's largest consumer.(Sinclair et al., 2014). The edible seed belonging to the yearly legume soy (glycine max), frequently referred to as sojabean or soybean, and is a member of Fabaceae plant species. As a major ingredient in many chemical products and a source of vegetable protein for countless people, Soybean represents a highly economically important bean. In regards to area covered and output, soybean (*Glycine max* L. Merr.) represents the fourth most important crop in the human planet. The most significant and protein-rich food source produced globally is soybean, which is a very considerable type of oil seed. Since it represents a leguminous crop with a capacity to synthesize nitrogen from the atmosphere with the aid of friendly bacteria, it is additionally recommended to utilize it for a supplier of soil nutrients. Moisture is an important environmental issue reducing soybean yield globally as well as in the United States. The cultivation of soybeans is primarily influenced by several natural pressures. Despite a number of soybean(Fried et al., 2018).

The top five soybean-producing nations worldwide are, in order, the United States, Brazil, Argentina, China, and India. A characteristic of soybean is the fact it belongs to the legume and develops a mutually beneficial relationship combined with Brady rhizobium japonicum, or rhizobia, which causes nodules to develop upon the root system. The nitrogen gas in the atmosphere is fixed via these nodules into a substance that plants can use. One significant benefit of soybean is the fact that it doesn't need nitrogen fertilizer since it fixes nitrogen.(Adamič & Leskovšek, 2021) .

The soybean belongs to the legume that is widely cultivated globally. Only roughly 150 years back was the first soybean introduced to Europe after being produced there for many, many years. Although being largely assumed to be a recent arrival to Europe, it's actually the most commonly planted crop legume there and does strongly. The USA as well as Brazil are both countries that send the most soybeans and soybean meal, as well as production across Europe are great and equivalent to those in both of these countries.(European Council, 2017).

2.2 Botanical and physiological characteristics of soybean

The tall, branched soybean plant grows to a height of almost two meters. Flowers that self-fertilize are either white or a tinge of purple. Although the majority of commercial types have brown or tan seeds, with 1-4 seeds per pod, seeds can also be yellow, green, brown, black, or bi-coloured.

The genus Glycine has been separated into two subgenera based on traditional and molecular taxonomy; the subgenus Soja (Moench) F.J. Hermann comprises soybean and its wild annual ancestor *G. soja Sieb*. & *Zucc*. Both species are members of the major gene pool, have 2n = 40 chromosomes, are cross-compatible, and generate viable F1 plants

2.3 Climatic Requirements

Because its roots are very short, it restricts intake of water in dry seasons, soybeans are not drought-tolerant. Soybean behaves poorly upon sandy soils and soils having little water retention, like gravelly or shallow soils. Clay soils with less rainfall have a lower likelihood of establishing new plants or sprouting of seeds(Nimje, 2017).

Soybeans require soil which is around 10°C in temperature in order to germinate. A favourable period for sowing is towards the final week of April or the beginning of May, particularly during mild springs or when producing crops on sandy soils in southern Sweden. To ensure the crop's production, seeding in the subsequent part of May will typically increase sprouting and it start to grow. Birds devouring the developing soybean plants might be a problem if early seeding is done. (Fogelberg, 2021).

The crop is cultivated under warm conditions in the tropics, subtropics and temperate climates. The ideal temperature for most varieties is 26 - 30°C. A lower temperature appears to setback the flowering. Day length is the crucial element in most of the soybean varieties because they are short day plant(Nimje, 2017).

Our findings conclusively demonstrate that, as an outcome of having a longer blooming stage, higher temperatures in long-maturing cultivars improved output by enhancing sources (leaf area and photosynthesis) and sink size (number of flowers, pods, and seeds). (Kumagai & Sameshima, 2014).

The average temperature, humidity index throughout the potential growth season, plus the annual temperature range are the three key atmospheric factors that affected the distribution of The average temperature, humidity index throughout the potential growth season, plus the annual temperature range are the three key atmospheric factors that affected the distribution of soybeans. (Zhao et al., 2021).

The main climatic element influencing a great deal of soybean phonological processes and phases is average temperature. Producers are able to alter their operations in response to climate change by using more-duration cultivars and later sowing times. (He et al., 2020).

Based on a multi-model average technique that takes the average among the three adjusted models, a single 1.5 °C increase in temperature will lead to a decrease in yield in the Mississippi Delta region if no modification procedures are performed. Consequently, it is imperative to develop suitable adaptation and mitigation strategies to prevent any potential loss in soybean production brought on by coming climate change. (Sun et al., 2022).

2.3,1 Rainfall requirements

For a productive yield, soybean needs 400 to 500 mm of water every season. When plants are germinating, blossoming, and reaching the capsule-forming stage, they need a lot of moisture. Nevertheless, ripening requires dry weather. Soybeans can withstand brief periods of flooding, but during the rainy period, seed ageing is a significant issue (Nimje, 2017)

2.4 Soil requirement

Soybean growing is best suited to loam soils having a pH between 6.0 and 7.5 which is fertile, adequately drained. Seed germination is inhibited by sodic and salinized soils. Soybeans may grow on soil that is just mildly acidic. However, they cannot tolerate highly acidic soils(Nimje, 2017).

Soybean yield wasn't associated to both physical and biological soil parameters in the comprehensive Cornell Assessment of Soil Condition, however it correlated with the proportion of soil respiration to soil organic material. Soybean production and saturation conductivity of water are positively correlated. (Faé et al., 2020).

To preserve the accessibility of nutrients, keep the pH of your soil appropriate. Soil should have a pH of 6.5 or higher in order to produce soybeans. Soybeans need soil which is warm, moist, as well as aerated in order to allow for optimal seed-to-soil interaction and hasten germination. Soil should have a pH of 6.5 or above in order to produce soybeans. A proper seedbed need to be free of active weeds, provide enough soil moisture, stop erosion by wind and water, plus be suitable for use with the sowing tools now available on the marketplace. (KSU, 2016).

2.5 Agronomic techniques for soybean production (elements of technology)

2.5.1 Variety selection

Before estimating the expected yield of any variety, spend some time learning as far as possible regarding its characteristics. Consider the culmination of a variety across plenty of years and a numerous of locations. This is crucial because every variety's achievements varies across year to year as well as from place to place depending on factors such as the climate, management strategies, as well as variety modification. (KSU, 2016).

Although possessing an extremely big and complex genome, significant advancement has been achieved using molecular cytogenetic methods to ascertain its special purpose and improve cultivars. Utilizing both traditional and modern plant breeding techniques, numerous reliable, high-yielding cultivars have been produced that are additionally resilient to abiotic as well as biotic stresses (Pratap et al., 2012).

APSIM proved capable of simulating the fluctuations of LAI and biomass development throughout a range of genotypes and seasons when phenology was correctly duplicated. Our research showed a substantial, although not a size-related, relationship between grain output and grain quantity. To simulate yield variance, future model improvements may emulate grain filling processes (grain amount as well as grain filling frequency) and how they vary within cultivars. Further event modelling () indicates that APSIM also caught the genotype by surroundings link that affects yield. (Wu et al., 2019).

Early sowing appears to be a more effective way for late cultivars to avoid water stress than early cultivars. The thermophilic characteristic of soybeans should not be used as an excuse to ignore heat stress during seed formation. The performance of soybeans is severely impacted by temperatures exceeding 28 °C (Schoving et al., 2022).

The rise duration of Chinese soybeans was most significantly influenced by latitude and seeding time, but GP reactions to external conditions differed between environmental-regions. Relevant ecological variables must be considered while attempting genetic amendments to different environmental-regions' development periods. (Xiao-bo et al., 2016).

Each landrace possesses potential features that may be used to boost the country's soybean yield. It was crucial to look for any the physical features associated with the cultivars in the various settings either sprightly or secondarily increased yield. (Shrestha et al., 2023).

According to the results, using genome selection strategies based on haplotypes rather than solely on polymorphisms of one nucleotide boosted the precision of prediction by as much as 7%. We also discover a promising haplotype block on chromosome 19 which has a significant impact on output and its subdivisions and may be used to demonstrate cultivars of weather-resistant soybean with improved yield in massive breeding programs (Yoosefzadeh-Najafabadi et al., 2022).

The primary factors influencing variations of soybean production were the soil's physical properties and the accessibility of moisture to crops. As a result, it may be concluded that ecological factors have a bigger influence than crop cultivation parameters. Just phosphorus did the effects of the nutrients supplied to the soil matter significantly. The timing of planting the prior crop, and the application of pesticides to safeguard plants are all factors in crop management and have little bearing on grain production including the variation in produce-related characteristics. (Wójcik-Gront et al., 2022).

The largest yield characteristic was technical level (TL), which had a mean CV of 31.4% in all 14 locations. Seeding date, soil, and variety maturity category also had yield variables with greater CVs. In certain crop periods, the time of sowing and variety maturity category both shown greater CV than technological stage, however issues varied depending on the growing summer's conditions. (Battisti et al., 2017).

Depending upon how moistened soybeans are, different soybean expellers have different compositions and qualities. Controlling the water content of soybean seeds precisely is essential for improving oil extraction, establishing homogenous expeller the chemical makeup, and ensuring the elimination of anti-nutritional elements. (Maciel et al., 2020).

In India, the mean yield is 1.2 t/ha, although the expected yield of rain fed soybeans is about 2.1 t/ha. Therefore, there exist significant yield discrepancies between farmers' anticipated and real outputs (Agarwal et al., 2013).

2.5.2 Nutrient management

Nutrient absorption is just one among several critical phases that influences soybean growth and output under many conditions, including stress. Reduced intake of minerals including copper (Cu), iron (Fe), zinc (Zn), manganese (Mn), and potassium (K), as well as calcium (Ca), magnesium (Mg), iron (Fe), and zinc (Zn), has a detrimental effect on how well soybeans respond to stress. Many variables, such as root design, crop genetic makeup, climatic conditions, physical variables (including soil properties), and symbiotic and autonomous soil microbes, have an impact on how well soybeans absorb nutrients. (Miransari, 2016b).

The kind of minerals found within the soil, the way they are utilized and taken in, how they interact with the different substances in the substrate, the manner in which the soil itself is handled, as well as the way fertilizer is administered all affect the quantity of minerals that may be used by soybean crops (Bagale, 2021).

The soybean crop is estimated to require as much as 80 kg of assimilated nitrogen, or 240 kg/ha on the mean, to produce a ton of pods. (Saranraj et al., 2021).

The goal of nutrient administration is to boost soybean yield while minimizing environmental harm. By using current and suitable mineral management practices, soy production may increase crop growth, maintain both grade plus yield improvement, and reduce environmental degradation (Hellal & Abdelhamid, 2013).

By combining natural manure, synthetic fertilizers, plus biological supplies and managing them correctly, it is possible to preserve soil health and profitability so long as giving crops certain amounts of the minerals they require (Loch, 2015).

2.5.3 Sowing depth and spacing

The recommended row width of 25 to 50 cm, however, allows for mechanical weed treatment using equipment that is readily accessible in the market and usually currently in operation on fields. Row distance will very marginally effect yields (Fogelberg, 2021).

In the northern part of Serbia, seeding soybeans at a seeding depth of 4-6 cm results in the best crops per space unit pattern and the fastest seed sprouting time. Increasing the seeding depth makes it feasible to postpone germination, extend the emergence period, and create a very significantly reduced plant density per unit area. If soybean seeds are placed in little depth than the recommended depth, sprouting takes longer and consequently fewer seedlings develop(Dozet et al., 2020).

Soybeans germinate most effectively when seeded at a hole of 4.0 cm in sandy soil. The dimension of soybean seed has no impact on how deeply it is planted the seed in sandy soils(Limede et al., 2018).

The 5 cm planting depth resulted in the greatest biomass output, the tallest plant, with the greatest stem width, the highest number of leaves each plant, plus the greatest length of root. Following that, with this sequence, seeding depths of 3 cm, 2 cm, and 7 cm were used. Seeding at a depth of 9 cm resulted in the dwarf plant, smallest stem width, minimal leaves each plant, narrowest root, and lowest organic matter yield. Considering the soil and weather circumstances of the study, the highest rate of growth and dry biomass output was achieved (Aikins & Afuakwa, 2011).

With shorter row distance, soybean weed return is often reduced. Multiple investigations have directly connected this impact to close-row systems' faster rate of canopy closure and lower rate of light collection at the soil surface. Additionally, according to the information that is currently available, close-row soybeans are considered to have a later crucial period for weed management than broad-row soybeans. (Khan et al., 2020).

We found that a decrease in row distance significantly increased the factors such as plant height, pods per plant, grains per pod, mass of one thousand grains, and production. Therefore, according to these tests, we suggest cultivating soybeans with 0.25m between crop rows (Garcia et al., 2018).

Early sowing appears to be a more effective way for late cultivars to avoid water stress than early cultivars. The thermophilic characteristic of soybeans should not be used as an excuse to ignore heat stress during seed formation. The performance of soybeans is severely impacted by temperatures exceeding 28 °C (Schoving et al., 2022).

Row distance and seeding density have no immediate effect on the production of soybeans, demonstrating the enormous phenotypic plasticity of the soybean crop that is reliant on the amount of temperature and rainfall in a particular agricultural area. Regardless of row distance, lowering seeding levels (Jańczak-Pieniążek et al., 2021).

2.5.4 Diseases and pest management

Fungi, viruses, as well as bacteria constitute the three primary types of pathogens that adversely harm soybean seeds. The bulk of pathogens that harm seeds are fungus, although significant illnesses of soybean seeds are carried on by bacteria and viruses. (Rupe & Luttrell, 2008)**.**

Pathogens as well as pests such as insects usually cause production limits in both natural and synthetic soybean agriculture, however treatment in both systems usually varies. (Hartman et al., 2016).

The majority of seed companies give immunity to diseases scores for phytophthora root and stem rot, signs of sudden new-born mortality, soybean mosaic virus, and stem canker. Some people are beginning to express immunity to frog eye leaf spot. In these fields, diseases like phytophthora root and stem rot or unexpected death syndrome are probable to recur, hence tolerant soybean types with high yield potential need to be sown. Bottom farms with regular early fog or mist are more likely to develop frog eye leaf spot. Certain environments favour varieties of soybeans with high crop yields and resistance to frog eye leaf spot. (Lee et al., 2014)

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Bean Fly/Stem Fly (*MelanagromyzasojaeZehntner),* Soybean Aphids (*Aphis glycines* Matsumura), Common Cutworm (SpodopteralituraL.) Soybean Leaf Folder (*OmiodesindicataF*.)Green Looper (*ChrysodeixischalcitesEsper)*. Soybean Pod Borer (*EtiellazinckenellaTreitschke*) are common insect pests of soybean(Dashti et al., 2016).

2.5.5 Harvesting

Soybean harvests can mature in 90 - 145 days, based upon cultivar. The leaves of a mature plant become yellow, and the crop's pods fall away of the stem. Soybean pods soon go brown and eliminate water. During harvesting, the water content of the seeds needs to be about 17%. (Mabehla et al., 2018).

In the 2019–20 harvest season, a total of 340 million tonnes of soybeans were harvested globally. This equates to an aggregate area of 123 million hectares. Together, the three biggest exporting countries—the United States, Brazil, and Argentina—produce over 80 percent of the world's soy. Soybeans, soybean meal, and soy oil have been brought in globally in a total amount of 238 million tonnes. (Kuepper & Stravens, 2022).

2.5.6 Post-harvest

The following procedures should be performed to reduce post-harvest losses.

To minimize losses after harvest, the subsequent actions need to be taken.

Quick harvesting with the right amount of moisture, gentle handling Implement grading procedures, employ efficient packaging. Apply aeration, fumigation, and Move inventory using bags, Waste at the field as well as market levels are decreased by appropriate soybean treatment (putting as well as unloading) in conjunction with effective transportation techniques.(Mabehla et al., 2018).

Following harvest, a variety of processes are used to maintain the standard of agricultural goods and their by-products. Since grain quality cannot be enhanced once it has been harvested, it must be preserved through appropriate post-harvest management practices, like cleaning, drying, packing, and/or storage. In considering this, adherence to appropriate sanitation measures and improved value chain management can prevent losses after harvest of grains, like soybeans. It is important to promote sealed storage plus triple packing since they are effective and efficient. (Cyril et al., 2019a).

Any containers utilized for storing soybean seed should be healthy, tidy, and manufactured of a substance that will not damage the yields and can't absorb water. The employed packaging material must have adequate aeration capacities, be compatible with natural surroundings and climatic conditions, and meet these requirements. (Mabehla et al., 2018).

If the crop is harvested while its water level is substantial, the seed's life is greatly reduced. For example, high moisture content seeds could be highly susceptible to fungus or other pathogenic organisms during storage. Thereby, lowering seed water content is an initial step in increasing seed life. For temporary storage (six to eight months), the optimum values for preserving humidity need to be reduced to around 12%, whereas for long-term storage (one to two years), Reduce the moisture level. (Mabehla et al., 2018).

Both amount and grade reductions were observed, the bulk of which happened at the time of storage due to biotic and abiotic factors. Utilizing technology throughout the entire process is necessary to reduce losses following the harvest, notably in containers for storage and packaging that uses tight and triple securing, accordingly. (Cyril et al., 2019b).

2.5.7 Economic importance of Soybean

In terms of agriculture, the soybean business appears to have a promising future. It may improve soils, provide a meaningful set of activities, and serve as a substitute crop suitable for little and enormous scale producers. (Meyer et al., 2018).

Soybean is one of the rare legumes that contain all nine necessary amino acids and a full protein. Mostly, it is ground into soy meal and oil. Following to palm oil, soy oil is among the most widely used edible oil worldwide. (Voora, Bermúdez, 2010).

Soybean is the most important crop due to its superior chemical composition. Soybean seeds consist of 36% protein, 19% oil, 35% carbohydrate, 5% minerals, and several other nutrients, as well as vitamins. It is considered the ideal crop for greater food security, a healthier diet, a supply of functional crops, and cooperation with many systems, including those involving animals**.** (Getahun et al., 2016).

A prominent legume crop which is cultivated across globe is known as the soy bean. It is farmed for human consumption, soil nutrient improvement, and the manufacture of commercial products including soy colours, harmless glues, flames, and coatings, besides other uses. Furthermore to being used to make roasted beans, soy paste, and cooked soybean yogurt, soybeans can also be used to make soy milk (tofu) or as an ingredient of protein by mixing with corn and wheat dough. Innovative products like yogurt-based ice cream plus soybean cheese, plus baking and nutritional items, all make use of plenty of-fat soy flour. (Murithi et al., 2016).

Soybeans include large amounts of proteins, vitamins, lecithin, isoflavonoids, micronutrients, and macronutrients .Because of the substantial amount of natural activity, soybeans may be employed in many pharmaceutical industries to make drugs as well as nutritional products. The soybean is a substantial source of peptides with a variety of biological effects, involving that which have been shown in diverse systems to possess against-diabetic, versus-cancer, against-inflammatory, anti-hypertensive, versus oxidant, anti-obesity, and immune-stimulatory properties. Although the reality that there is a wealth of information about the medicinal uses of soybeans (Dukariya et al., 2020).

Additionally, soybeans can be grown and used as a vegetable or salad ingredient. They can also be cooked and consumed as a snack item. Edamame, or immature soybeans, are frequently steamed or cooked and consumed straight from the pod. To make margarine, shortening, vegetarian and vegan cheese, soybean oil can be processed.

According to Role et al., (2004) Soybean provides a number of nutritional and medical benefits. For example, soy oil is crucial for preventing persistent (cancer) and non-communicable illness. Additionally, soy products naturally include proteins, fats, carbohydrates, fibre, minerals, phytoestrogens, and are used as animal feed. Soybean provides a staple in the foods of many civilizations, both for humans and animals, and is one of the most accessible and inexpensive suppliers of protein. The protein content of the seed nourishment, which is composed of 63% meal and 17% oil, is 50%.

Since soybeans don't consist of any carbohydrate, they make a great protein-rich diet for diabetics. Asian cuisine frequently uses soy sauce, a salty, dark liquid produced from crushed soybean plus wheat that undergoes yeast growth in salt water for six months to twelve months or longer. Since soybean is a leguminous crop with the potential to alter nitrogen gas in the atmosphere to raise fertility in the soil and preserve and enhance the condition of the environment, it contributes to the durability of the soil. (Asodina et al., 2020).

Pagano & Miransari, (2016) have been noted that in the biological relationships of soybean, mycorrhizal fungi and rhizobia have the highest capacity as bio-fertilizers in it.

Soybeans are mostly farmed and eaten as food all over the world. Furthermore, soybean possesses an extended history being utilized as a food source and medical herb. SG2626E inhibited IAV infection by reducing within-cell calcium levels of penetrated human pulmonary epithelial A549 cells. Additionally, SG2626E lessened body weight loss, decreased fatality, and increased life spans in mice infected with IAV by reducing viral multiplication in their lungs (Kwon et al., 2022).

The fibre created from soybean protein is healthy, comprises a lot of amino acids, and has an excellent liking with our skin. Throughout the method of turning soybean protein fibre into fibre, the addition of Chinese traditional medicine with the advantages of sterilizing and an ingredient that reduces inflammation will combine with the lateral chain of the amino acid in the form of a chemical bond (Li, 2004).

The consumption of animal products, including meat, dairy, eggs, and farmed fish, constitutes the biggest portion of soy product consumption. When soybeans and soybean oil are consumed by humans, an extra 3.5 kg are produced, whereas utilizing soybean oil in industrial goods like biofuels is thought to produce an additional 2.3 kg (Kuepper & Stravens, 2022).

2.6 Tillage effects on soybean production

Kiszonas (2010) asserts that there are no appreciable differences within traditional cultivation and zero-tillage systems for growing soybeans.

According to the present research, soybean production during the early stages of the switch to reduced and no-tillage systems can produce good results if adequate crop and weed control strategies are used. (Adamič & Leskovšek, 2021).

Soybean yields are influenced by external characteristics, soil capacity to hold water, biological characteristics, plus growth of root systems. The zero-tillage method increases crop water availability and yields soybeans well. (Ferreira da Silva et al., 2022).

minimal tillage and no-tillage techniques can be utilized to cultivate soybeans in the soil properly without having an adverse effect on the total isoflavone concentration(Mureșan et al., 2020).

Yin & Al-Kaisi, (2004) stated that: With time under extended term management ranging from 8 to 15 years, the differences in soybean grain yields and economic returns between no-till, mould board ploughs, ridge tillage, chisel plough or other tillage methods do not alter significantly. No matter what tillage strategy was used, soybean yield performance remained constant throughout time.

According to Buah et al., (2017) no-tillage soybean farming with fertilizer typically produced the maximum crop yields. The biggest economic gains came from no-tillage farming. Even on degraded savanna soils with low amounts of nutrients accessible to plants, farmers may produce soybeans with no-till and yet see good yields on their herbicide investments than they might with their conventional method.

After an earlier 11-year lag, NT soybean produced continuously high and stable crop yields(Sindelar et al., 2015).

Tillage practices significantly affect plant height, fruit number, 100 seed weight, seed output, and oil content, as per average values over two years. The traditional tillage practice significantly affects plant height, fruit output, harvest index, and plant lipid content(Ozturk & Sogut, 2016).

No-tillage participants produced the maximum soybean yield with water-deficit treatments. The cause of this is that the no-tillage strategy reduces surface evaporation, which in turn preserves the water content of the soil and lessens crop water stress(Gonen & Kara, 2022).

Systems of soil tillage have a considerable detrimental impact on the number of nodules generated in the root systems of soybeans at the beginning and conclusion of the nitrogen fixation process. Tillage system has a very substantial negative impact on protein content and a significant positive impact on soybean fat content(Chetan et al., 2016).

Root dried matter mass and soybean yield were significantly associated, and vehicles-related soil compaction has an impact on yield. It was clear that the 58 kN differential in the machinery resulted in a decrease in yields regardless of whether extensive tilling was applied. (Botta et al., 2010).

As a consequence of better soil temperature plus preserving water, enhanced crop yield in raised beds using traditional tillage shows that adequate water in the soil plus additional nutrients have been utilized more efficiently under preservation tillage practices (Rajanna et al., 2022).

According to Singh et al.,(2008) recommendation, traditional cultivation is preferable to minimal and no tillage in mountain agriculture conditions. Nevertheless, according to asset endowment, no cultivation and less cultivation could be taken into consideration in terms of energy savings and a decrease in soil erosion.

The application of straw that had undergone nitrogen treatment resulted in a considerable increase in soil water content and a decrease in soil temperature. The change in soil hydrothermal properties brought about by the S + N treatment resulted in a boost in soil microorganisms which improved soil condition and production (Akhtar et al., 2019).

Tillage affects the makeup of the soil, which in turn affects the soil's water cycle, plant growth, and the efficiency of water use. For the particular silt, zero-tillage (direct seeding) and decreased cultivation (cultivator use and quadrennial subsoiling) result in greater crop yields.-loam soil and moisture-limited circumstances, such as ploughing. (Liebhard et al., 2022).

In soils with a small amount of biological matter, cultivation methods can change soybean nodulation and production. Less tillage also improved seedling development, soil cover, and grain yield. Thus, restricted cultivation as a sustainable agronomic strategy offset the negative effects of no-tillage and may improve crop biomass, soil microbes (particularly -glucosidase and dehydrogenase enzymes), and soybean grain yield(Farhangi-Abriz et al., 2021).

Soil tillage techniques, are very meaningful negative impact on the development and setup of nodules in the root system of soybeans in which nitrogen fixing bacteria is available from which the soybean nourishes nitrogen. Tillage technique expressively positive impact of oil content in soybeans and very noticeable negative impact on protein content (Chetan et al., 2016).

No-tillage yields the highest plant water production, while conventional tillage yields the lowest. In addition, evaporation losses from conventional and reduced tillage are higher than those from no-tillage. The changes in canopy formation caused by tillage are visible in the time- related evolution of transpiration rates, late development under no-tillage(Liebhard et al., 2022).

In an incorporated management strategy, the selection of the seed furrow opening mechanism can be employed to prevent soil compaction. The least restricting water range was the soil physical characteristics that most strongly linked with soybean yield followed by soil bulk density, water and air storage capacity, resistance to penetration, and the least restricting water range. These soil physical qualities all affect soybean yield(Ferreira et al., 2023).

No till practice was supposed to be conductive to improve the microbial activities of soil (particularly β-glucosidase and arylsulfatase enzymes), plant biomass and consequently soybean grain yield. The main gain of this study is that the increase in soybean productivity converges with positive (desired) values of physical, chemical and biological properties of the soil(Serafim et al., 2023).

In a wheat-soybean double-crop system in Arkansas, native earthworms predominated alongside a common invasive species, and earthworm densities were influenced by the interplay of tillage with combustion and application of soil nutrients to affect the amount of wheat residue(Thomason et al., 2017).

Results show that straw stubble covering may significantly increase the content of OM, OC, nutritional elements, and other soil chemical characteristics, and conservation tillage can successfully modify the soil chemical properties(Lv et al., 2023).

It is confirmed that ZT is a workable and viable strategy for better and sustainable agroecosystem, nutritional safety, and ecological resilience based on a variety of latent immediate and secondary advantages, resource-saving capacity, and broad introducing extent(Hassan et al., 2022).

Through altering the soil's physical properties in corn-soybean alternation plots, tillage appeared to have an impact on H. glycines population densities. In rotating soils, lowering H. glycines population densities through reduced tillage intensity was helpful. The option of tillage strategy might thereby lessen the possibility of suffering from this extensively dispersed disease(Westphal et al., 2009).

In comparison to the tillage system and starting N, this influence was substantially greater. Protein and precipitation were found to have a negative correlation coefficient, r = -0.96, while oil and precipitation had a positive correlation coefficient, r = 0.81. Seed yield was considerably impacted by the tillage system (P 0.01).Conventional tillage produced the highest average yield (2.60 t/ha), next by reduced tillage (2.39 t/ha), and no-tillage (2.11 t/ha)(Fecák et al., 2004).

Because soil tillage has a significant impact on soil and plant qualities, it can be seen as a key strategy for reducing the stress that soybean growth and yield production are under. By enhancing the characteristics of the soil and thereby raising the productivity of the soil, the right tillage technique can reduce the negative impacts of pressure on plant growth and yield offering. No tillage (NT), in which crop debris is left on the topsoil and no agricultural machinery is utilized in the field, is one of the most efficient techniques of soil tillage. By raising soil moisture (decreasing the amount of water lost from the soil surface), altering soil temperature, enhancing soil structure, and boosting the level of humus, the application of NT can alter a variety of soil variables, including the physical, chemical, and biological ones(Miransari, 2016a).

Serafim et al., (2023b) mentioned that long-term NT practice was anticipated to contribute to an improvement in plant biomass, soil microbial activity (especially -glucosidase and arylsulfatase enzymes), and ultimately soybean grain production.

(Kiszonas, 2010) concluded that no differences exist between soybean grown in conventional tillage and no-tillage systems in Iowa and that local adapted cultivars can be selected to maximize yield regardless of tillage system in Iowa.

In general, full irrigation and traditional tillage techniques generated the highest soybean yield. The no-tillage groups, however, produced the maximum soybean yield with moisture deficient treatments. The cause of this is that the no-tillage strategy reduces surface evaporation, which in turn preserves the moisture content of the soil and lessens crop water deficit(Gonen & Kara, 2022).

Deep tillage in the fall instead of ancillary irrigation during the pro-genitive period was used to grow soybeans, which resulted in produces that were comparable to those of normal production techniques with irrigation, substantially higher than those of customary production technologies without irrigation, and produced net returns that were considerably greater than those of traditional production tactics with and without irrigation. These findings suggest that tillage advice for clay soil should take into account the advantages of sub-soiling when the soil is still completely dry(Wesley et al., 1994).

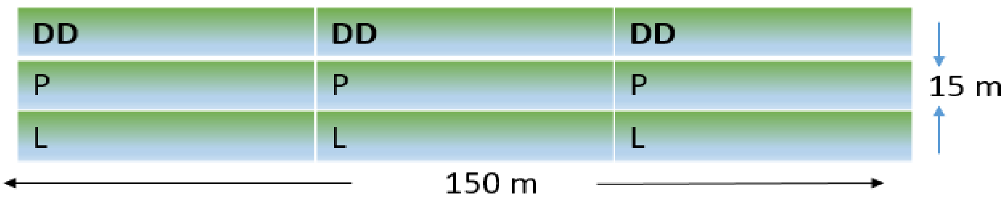
Traditionally tilled soybean fields (Ploughing and Ploughing+ Harrowing) produce superior plant height, leaf area, number of pods per stand, and seed yield than non-tilled parcel (No Till and No Till + Hoeing).Tillage treatment had a statistically meaningful impact on plant height, the number of leaves per stand, the area of those leaves, the number of pods per stand, and seed yield(Lasisi & Aluko, 2009).

3. Materials and Methodology

3.1 Description of the study area

The research work was conducted at Szárítópuszta, Gödöllő town of Hungary. The institute is located about 2 km east of the Hungarian University of Agriculture and Life sciences, at (N 47° 35' 47.65", E 19° 21' 18.54") Longitude and latitude respectively and the altitude is 210 m above sea level. The soils is classified as Luvic Calcic phaeozem and it was highly degraded or poor soil due to intensive cultivation and which was formerly sown winter wheat formerly .The mean annual precipitation of the study area is about 600mm and the annual mean temperature of the area is -4.4 -26.6 ^{0}C.

3.2 Experimental design and layout



The experiment was laid out in a Random Strip Design. The three tillage treatments were replicated three times thus a total of 9 field plots measuring 50 m long and 5 m wide were used.

The lengths of all the plots were parallel. Tillage was performed after the first rains in May and planting was done immediately. Sowing method was broad casting

3.3 Tillage Treatments and their descriptions

3.3.1 Direct drilling (DD): crop remnants stay above the land's surface during harvesting until planting whenever seeds are sown utilizing the DD tillage. Tiny opening is carved through the soil with disc at depth of 1-5 cm.

3.3.2 Loosening (L) or Subsoiling is the loosening and non-inversion cultivation that occurs at an average depth of 28-35 cm. Subsoiling generally advantageous for soils which have been compressed by automobile traffic, livestock, or processes of nature because it disrupts the compressed zone.

3.3.3 Ploughing (P): A dependable, tried-and-true tillage system which performs well for the majority of situations and offers a variety of special benefits is ploughing. The plough creates a surface free of straw and loosens the soil during a single pass at the depth of 25-30cm, allowing for the establishment of a fresh crop plus the creation of a seedbed.

3.4 Methods and Tools used

By measuring penetration resistance, one of the most widely used methods. In the trials, a manually operated spring-type soil penetrometer (MPa) was used to evaluate piercing strength. Soil penetration resistance was measured once a month from May up to October at a depth between (0 – 15 cm, 15 – 30 cm and 30 – 50 cm). Starting in May and continuing through October, the soil moisture content was assessed six times, once a month. At each treatment, samples were obtained at a depth between (0 – 15 cm, 15 – 30 cm and 30 – 50 cm) using Tensiometer (m/m %). By using dry sieving, the agronomic structure of the soil was studied. During May through October, soil structure measurements were performed once every month. To separate the air-dried soil specimens into their four component fractions, they were run through three sieves with pore diameters ranging from 10 mm to 2.5 mm to 0.25 mm. I calculated the weights of specific fractions, then by describing the quantity as %, I determined the structure of soil in terms of clods, crumbs, small crumbs, and dust.

3.5 Data analysis

The IBM SPSS V.27 software's ANOVA modules were used to statistically evaluate the outcomes. Multivariate Anova was used to analyse the effects of every treatment used on soybean at the level of 0.05 of probability. The significance of differences between data was assessed using LSD (least noticeable difference) testing. P 0.05 was used as the statistically important level.

4. Result and Discussion

4.1Result of soil penetration resistance

4.1.1. Soil penetration resistance between 0-15 cm

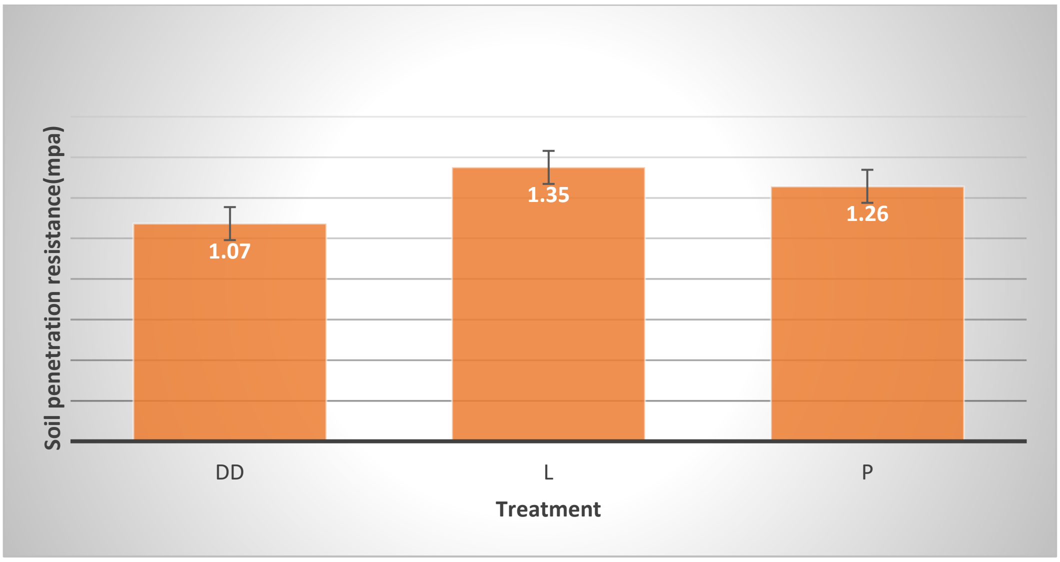


Figure 1: soil penetration resistance between 0-15 cm

The tillage treatments had no considerable impact on soil penetration resistance between 0 - 15 cm deep at $p<0.05$ level for the three circumstances ($F(2, 51) = 2.08$, $p = 0.13$). Figure 1 depicts the relationship between soil depth, tillage, and soil penetration resistance. The highest mean soil penetration resistance (1.35 ± 0.46 MPa), which was slightly higher than that of DD (1.07 ± 0.46 Map), was recorded in L. My findings are consistent with those of jean-françois et al. (2009), who found that ploughing decreased tightness. My findings, meanwhile, contradict those of Luz, Lustosa Carvalho, et al. (2022), who claim that traditional cultivation offers no extra benefits over decreased tillage in terms of reducing soil compaction. Impact of tillage methods on soil barrier to piercing 15 - 30 cm depth.

4.1.2 Soil penetration resistance between 15- 30 cm

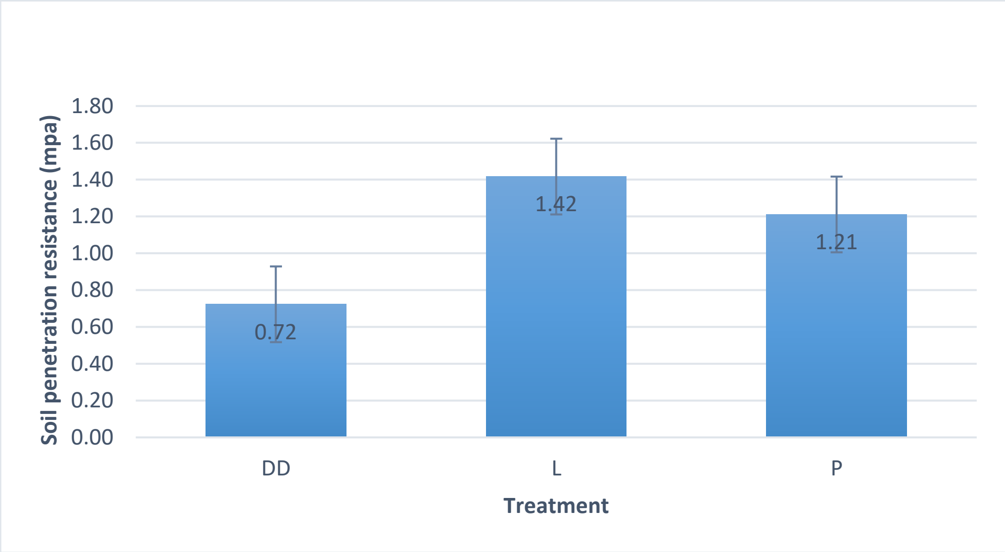


Figure 2: soil penetration resistance between15-30 cm

Statistically Strong effect of tillage was found for the soil penetration resistance data when averaged across 15–30 cm depth at $p<0.05$ level for the three circumstance($F (2, 51) = 4.54$, $p=0.01$). (Fig. 2) shows the relationship between soil tillage treatments, and soil penetration resistance. L tillage treatment produced higher penetration resistances than the DD and P. The highest values (1.42 ±0.64 MPa) was recorded in L and lowest was recoded in DD (0.72 ± 0.75 MPa). Comparable to this, Arman (1997) claimed that the penetration resistance is more significantly impacted by the soil cultivating system. This procedure is carried out in order to more accurately determine the resistance to penetration, which relies on the amount of water in the soil and sinking stage. The upper 20 cm displayed the most variation, and there was no variations across the deeper layer. Tillage significantly affected water permeability, apparent density, plus barrier to penetration across soil depths of 0–30 cm. Less area disturbed tillage practices had drawbacks related to the frequency of sampling and soil depth, and it compacted the soil greater than any other approaches (Ibrahim et al., 2017). Reaching a depth of 8 cm for all three treatments, the barrier to penetration rose to 1.8 MPa; nevertheless, at a depth of around 25 cm for traditional cultivation, the resistance dramatically decreased to 1.1 MPa. But in both decreased tillage-plots, the penetration barrier increased slowly, attaining 3.2 MPa at the level of 25 cm in decreased tillage-2 and 3.6 MPa at a deep of 22 cm in decreased tillage-1(Kuhwald et al., 2020).

4.1.3 Soil penetration resistance between 30-50 cm

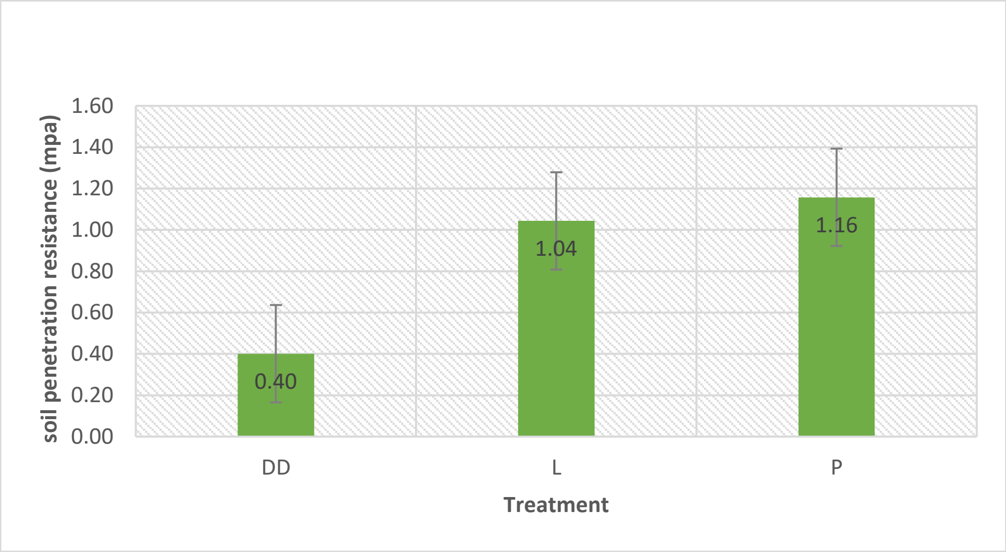


Figure 3: soil penetration resistance between30-50 cm

The tillage treatments had significant impact on soil penetration resistance between 30-50 cm deep at $p<0.05$ level for the three circumstances ($F (2, 51) = 3.23$, $p= 0.04$). (Figure.3) depicts the relationship between soil depth, tillage, and soil penetration resistance. The highest mean soil penetration resistance (1.16 ± 1.11 MPa), which was slightly higher than L and DD was recorded the lowest (0.40 ± 0.63Mpa). According to Földesi's (2013) research, each research's soil was appropriately loosen by ploughing to a depth of 30 cm. These trials produced results with a mean soil penetration strength below 3 MPa, indicating no adverse soil compaction. The depth where the initial indications of normal soil quality were discovered. A plough pan stratum was visible in the period under evaluation beneath the depth of ploughing, and it was only since the soil water content was significantly higher than average that the soil penetration barrier readings fell below 3 MPa. Soil loosening and adjusting depth of tillage could be recommended to stop tillage pan creation in the soil. My result is disagree with Luz, Lustosa Carvalho, et al.,(2022) assertion that conventional tillage offers no further advantages over less cultivation in terms of reducing soil compaction.

4.2 Result of soil moisture content

4.2.1 Soil moisture content between 0-15 cm

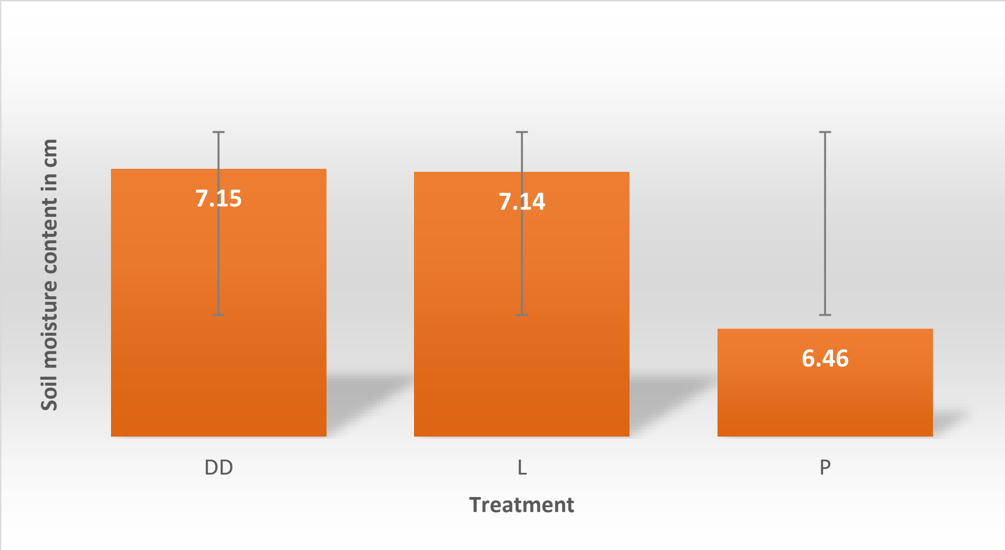


Figure 4 soil moisture content between 0-15 cm

Fig.4 shows the relationship among tillage treatments, depth and soil moisture. Tillage had no significant effect on soil moisture between the depth of 0 – 15 cm at $p < 0.05$ level for the three conditions ($F (2, 51) = 0.23$, $p= 0.71$). However the maximum soil moisture was recorded relatively equal in both DD and L(7.15 ± 2.90 m/m%).While on the contrary P tillage treatment recorded the lowest (6.50 ± 2.73m/m%) among the tillage treatments at the depth of 0-15 cm. During the moment of the penetration data collection, any variations in amount of water present in the soil among the tillage techniques were negligible (P>0.05)(Ibrahim et al., 2017). Water absorption throughout an increase of soil metric tension indicated that soil with no cultivation maintained a greater amount of water than soil with traditional tilling while both soils remained unsaturated. This may be accounted for by the reality that with No tillage there are greater numbers of macrospores in bulk than with traditional cultivation (Grove et al., 2004). For a silt loam as well as a sandy loam in northern British Columbia, constant over time No cultivating handling improved aggregate particle size distribution and strength, water movement and storage, overall and physically vital elements of soil biological matter close to the soil the outermost layer. Our research demonstrates that crop cultivation using no cultivation may help efficiently reduce the degradation of soil. consequently, possibly enhance ecological quality by lowering in the field run-off by increasing crop water intake (Arshad et al., 1999).

4.2.2 Soil moisture content between 15-30 cm

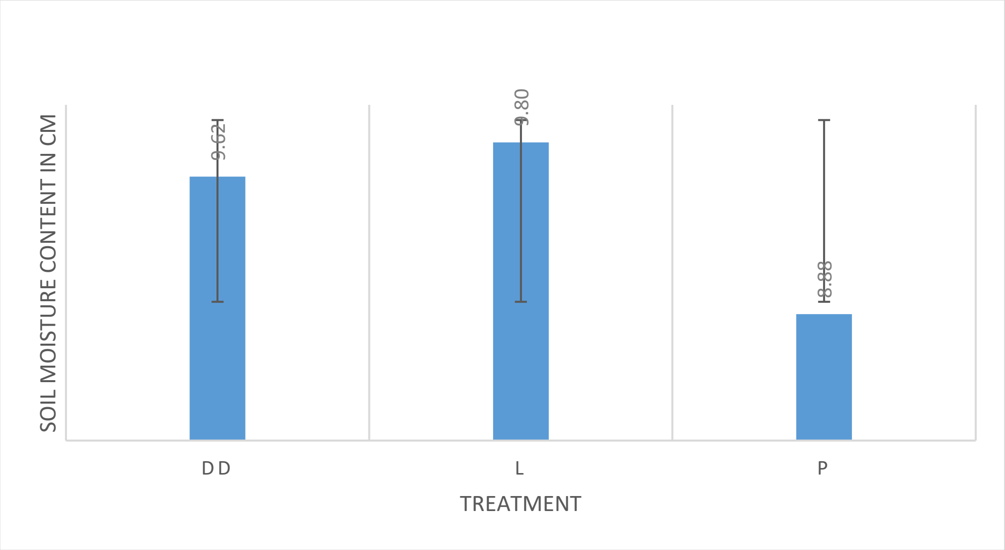


Figure 5: soil moisture content 15-30 cm

(Figure.5) depicts the relationship between soil depth, tillage, and soil moisture. The effect of tillage on soil moisture at a depth15 – 30 cm was insignificant at $p < 0.05$ level for the three circumstances ($F (2, 51) = 0.65$, $p= 0.52$).The highest moisture content in the top 15-30 cm layer of soil was in L (9.8 ± 2.58 m/m %), with only slightly less moisture content (8.87± 2.45m/m %) in DD. The minimum moisture content was measured in the upper 15-30 cm layer of the soil for P (8.8%). The effects of tillage techniques on water content in the top 15–30 cm of the soil were minimal. There was no noticeable difference comparing no tillage with sub soiling with regard to of soil water retention. (QIN et al., 2008). My result concurs with the result reported by Luz et al.,(2022), who indicated that soil disturbance by conventional tillage does not improve water availability.

4.2.3 Soil moisture content between 30-50 cm

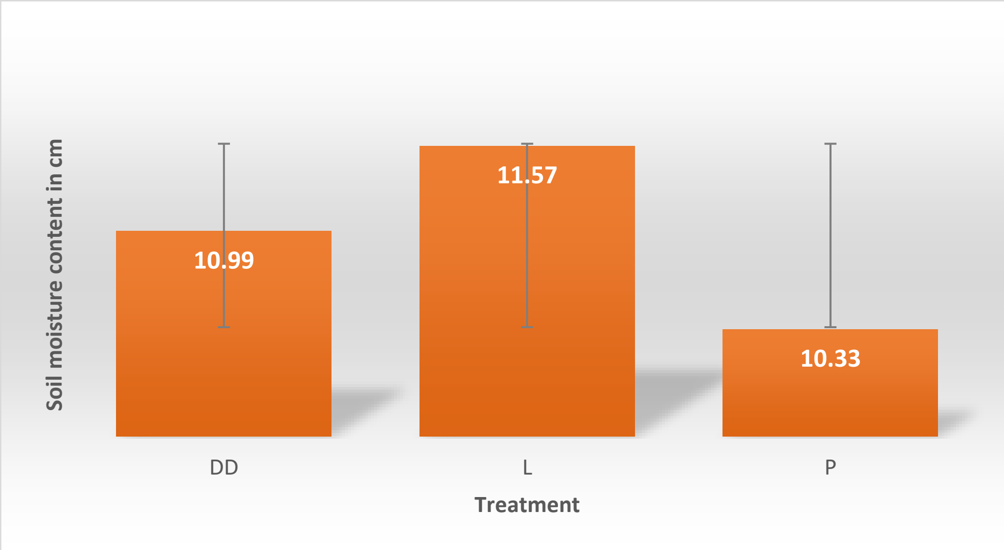


Figure 6: soil moisture content between 30-50 cm

Differences in soil moisture content between tillage treatments at the time of penetration measurements were insignificant at $p < 0.05$ level for all the three conditions ($F (2, 51) = 0.84$, $p= 0.43$). (Figure.6) depicts the relationship between soil depth, tillage, and soil moisture. For mean moisture content, there were no statistically significant changes across tillage treatments. However L treatment scored high moisture (11.57 ± 2.94 m/m %) Whereas P scored low soil moisture (10.32 ± 2.62 m/m %).Which concurs with the results found by Biberdzic et al.,(2020). however the highest soil moisture was recorded in loosening while on the contrary the lowest moisture recorded in ploughing at depth of 30-50cm.QIN et al.,(2008) stated that assessments of water in the soil taken at depths of 0-30 cm and 30-60 cm revealed differences in the comparative moisture between treatments. This discrepancy is bigger in 0–30 cm compared to 30–60 cm. There are no discernible changes in the treatments at layers of 0 to 30 cm and 30 to 60 cm, according to the findings of the variance calculation of the information on soil water content. In comparison to the no subsoiling treatment, the between subsoiling treatment possessed a higher water in the soil. The inter-row subsoiling caused the tough plow pan to split and the work stratum to be deeper, it additionally enhanced soil water penetration within the subsurface layer. (W. Wang et al., 2022). My result is in line with the result reported by Goulart et al., (2021), who indicated that soil moisture stored best in a chiselling technique.

4.3 Result of Soil Agronomic structure

4.3.1 Clod %

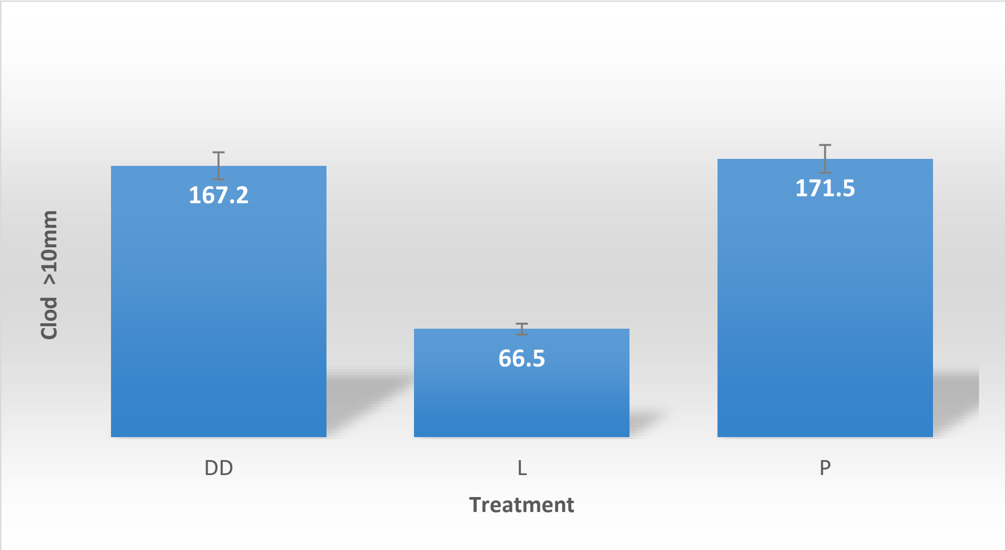


Figure 6: Clod %

Tillage had a significant impact on Agronomic structure clod % at p< 0.05 level for the three circumstances (F (2, 51) = 4.32, p= 0.02) as characterized by visual soil tests. Fig. 7 shows the Clod % scores for the DD, L and P plots. DD scored the highest (171.50 ± 144.36) clod % comparing to DD and L .Whilst L Scored the lowest (66.52 ± 35.11) clod %. The results of this research confirmed the notion that conventional plowing significantly altered the physical properties of the soil, which then in turn harmed the soil's structure (Pagliai et al., 2004). In our experiment, the highest ratio of clod was reached by P which is in agreement with a similar study by(Dekemati et al., 2021).

4.3.2 Crumb %

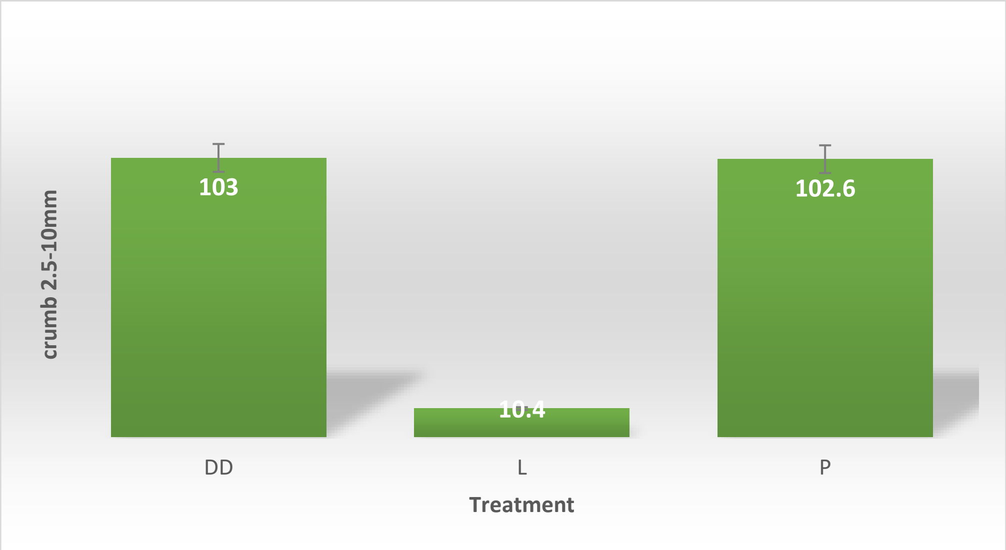


Figure 7 : crumb %

The effect of the applied tillage systems on the agronomic structure of the soil was also examined. Tillage had strong significant impact on crumb soil fractions % at the $p < 0.05$ level for each of the three circumstances ($F (2, 51) = 10.2$, $p = 0.00$). (Fig.8) shows relationship between % of crumb and tillage treatments. From the point of view of agronomic structure, the soil particles of 2.5-10 mm size can be separated into crumbs. The proportion of crumb fraction was high (103 ± 86.38 %) and 102.6%) in DD and P respectively, DD tillage treatments produces crumb that is similar to a P tillage treatment, with statistically significant difference among the three systems. The lowest when using L tillage treatment (10.4 ± 10.98 %). (Bencsik, 2009) stated that less disruption, such as direct drilling, enhanced the arrangement of soil particles and enhanced the percentage of crumbs while reducing dust.

4.3.3 Small crumb %

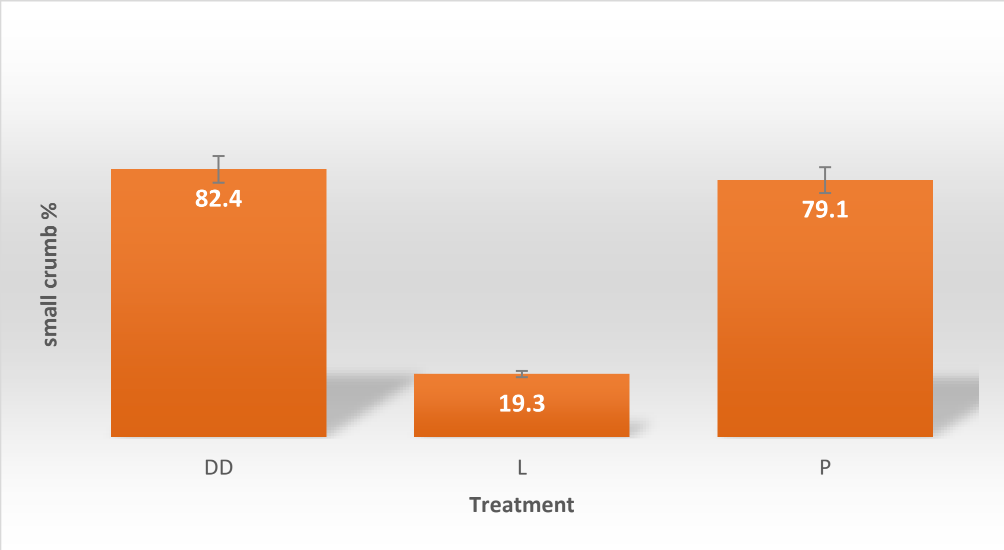


Figure 8 : small crumb %

Tillage had Statistical strong significant impact on small crumb soil fractions % at the p < o.o5 level for each of all three conditions (F (2, 51) = 15.32, p= 0.00). (Fig.9) shows relationship between % of crumb and tillage treatment. The largest small crumb fraction was found in DD (82.44 ± 43.39 %). whereas the smallest small crumb fraction was found in L (19.26 ± 20.24 %). Grove et al., (2004) stated that as a consequence of differences in mesopore percentages and macropore consistency, results suggest that soil structure could help reduce soil moisture evaporates to the atmosphere. The reason for ongoing No till soils' improved soil retention of water is the cohesion of tight soil particles with smaller intra-aggregate pore sizes that increase the retention of water and hence minimize runoff. Furthermore, the lack of tillage disturbance enables the strengthening of inter-aggregate the pores via a range of dimensions that significantly give to greater soil moisture utilization and preservation on a silt loam and a sandy loam in northern British Columbia, ongoing permanent NT supervision improved aggregate particle distribution as well as strength, water movement and storage, and entirety and physically important elements of soil biological matter close to the soil surface. Our results demonstrate that crop cultivation using No till may be used to efficiently reduce the degradation of soil, and consequently, potentially enhance the ecological condition by lowering on-farm wastewater by increasing crop water intake (Arshad et al., 1999).

4.3.4 Dust %

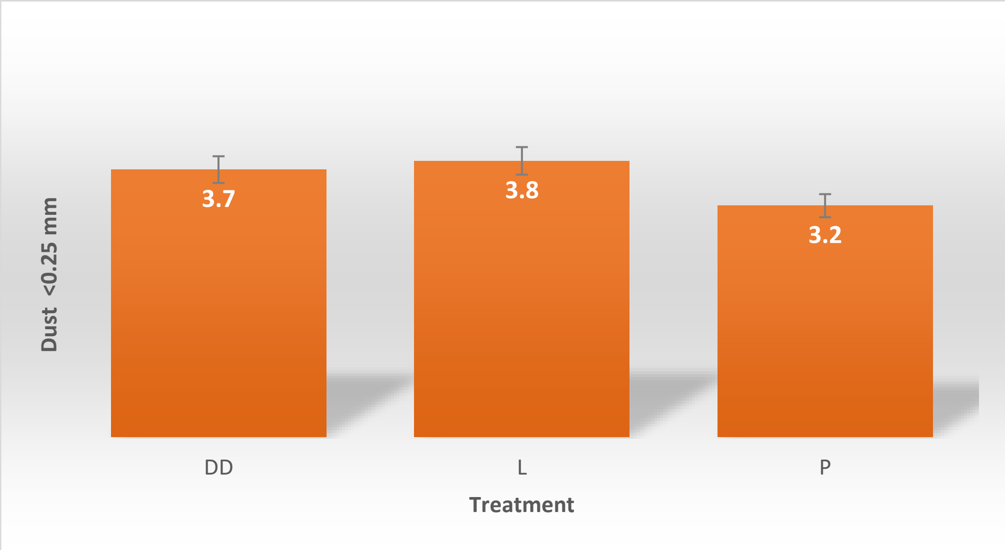


Figure 9: Dust %

Tillage had no considerable impact on the dust soil fraction % at the p < o.o5 level for each of all three circumstances (F (2, 51) = 0.11, p= 0.89). (Fig.10) shows relationship between % of crumb and tillage treatments. The largest dust fraction was found in L (3.8 ± 4.52 %) but no excessive dust forming was observed. No statistically proven differences were found in this regard among the three tillage treatments concerned. This may be explained by the fact that the land use affects agronomic soil structure on the long run. Bencsik,(2009) reported that the soil structure deteriorated over a two-year period due to the use of agricultural tillage techniques. The amount of the clod fraction grew while the crumb component declined. However in all treatments, the percentage of the dust percentage diminished.

4.4 Result of yield attributes

4.4.1 Plant density/m^2

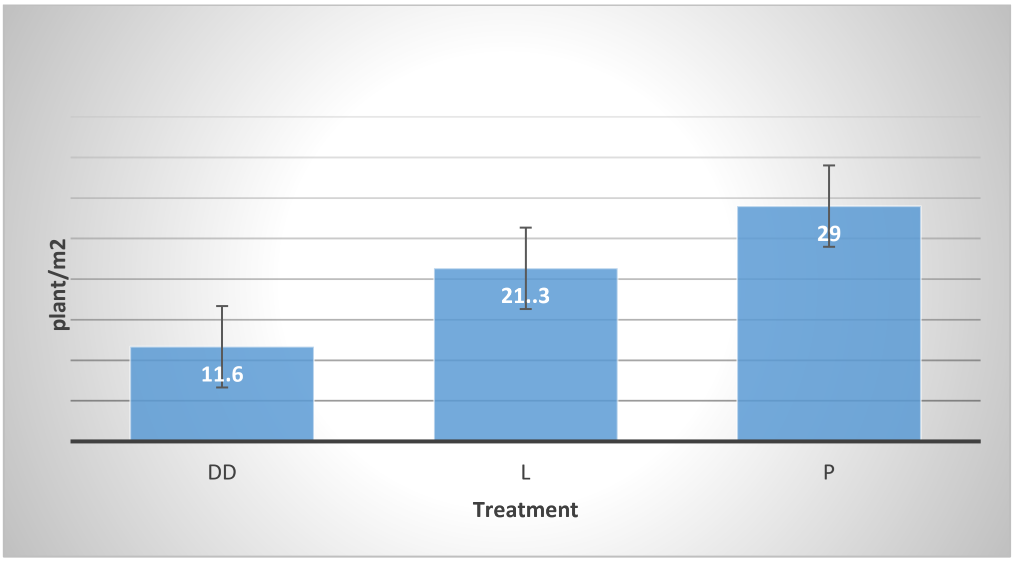


Figure 10: plants density/m^2

There was significant difference among the tillage treatments in number of plants per meter square at the $p< 0.05$ level for three conditions (F (2, 51) = 5.20, $p= 0.02$). (Fig.11) shows relationship between number of plants and tillage systems. The highest number of plant was recorded in P tillage (29 ± 8.10), while on the contrary the least number of plant was recorded in DD tillage (11.67 ± 4.14). (Adamič & Leskovšek, 2021) said that large quantities of the evaluated soybean growing measurements, such as plant density, nodes per plant, and shoot and root dry matter, were most highly concentrated in the traditional tillage approach. Gawęda et al., (2014) the crop density using traditional cultivation increased post germination and prior to collection by 39.5% and 31.7% in contrast with the results attained with direct sowing.

4.4.2 Number of pods/plant

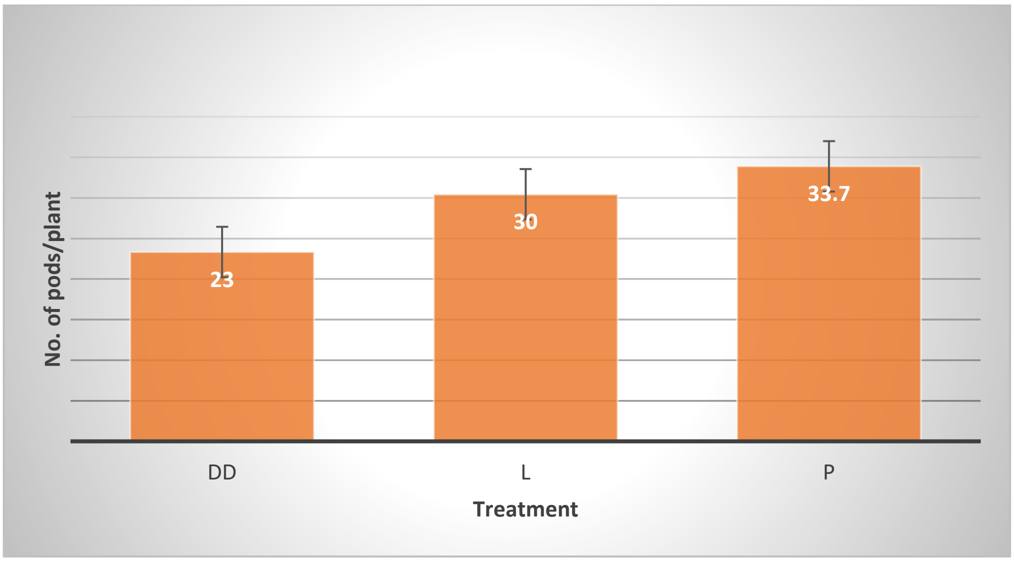


Figure 11 : number of pods/plant

Tillage had a considerable impact on the quantity of seeds at the p < o.o5 level for each of all three circumstances (F (2, 51) = 43.96, p=0.03). (Fig.12) shows relationship between number of pods/plant and tillage treatments. The maximum number of pods per plant was recoded in p (33.9 ± 15.44), whereas the minimum number of pods per plant was recorded in DD (23.33 ± 4.62). Monsefi et al., (2014) The least number of pods were generated with zero tillage compared to conventional tillage, according to Monsefi et al., (2014), most likely due to compacted soil plus an increase in invasion of weeds. Additionally Pinar & Yilmaz,(2008) noted that sub-soiling generated the most pods per plant during the initial and next years. Similar patterns were observed in the quantity of soybean pods per plant, a trait associated to soybean output. Notably, the Subsurface Tillage treatment produced the most pods per plant (27) than any other method of cultivation (Chorey et al., 2020).

4.4.3 Number of seeds/pod

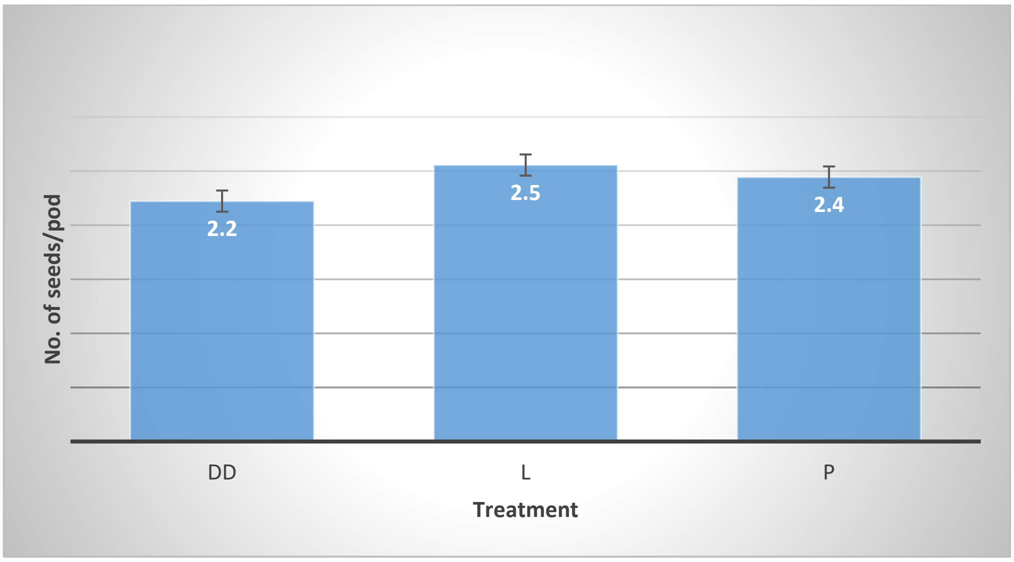


Figure 12: number of seeds/pod

Tillage had a considerable impact on the quantity of seeds at the p < o.o5 level for each of all three circumstances (F (2, 51) = 43.96, p=0.03). (Fig.13) shows relationship between number of seeds/pod and tillage treatments. The highest number of seeds was recoded in L (2.5 ± 0.32) tillage treatment, while on contrarily the least number of seeds was recorded in DD (2.22 ± 0.43) tillage treatment. It could be stated that the use of the subsurface ploughing method showed significant improvements in the growth and output-attributing features, which in turn showed a rise in the seed and straw production from the soybean crop. Subsoiling treatment markedly improved plant growth, yield traits in contrast with other tillage methods (Chorey et al., 2020).

4.4.4 Grain yield

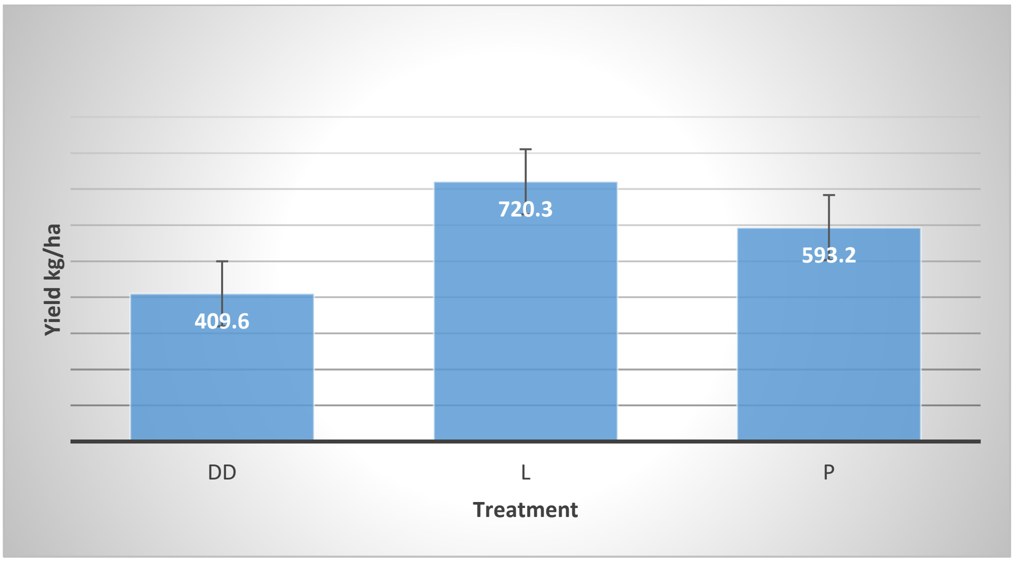


Figure 13: grain yield kg/ha

Tillage treatment effect had highly significant on yield at the p < 0.01 level for each of the three conditions. (Fig.14) shows relationship between yield and tillage treatments. Significantly lower yield was obtained in DD (409.62 ± 315.5 kg/ha), while the highest yield was achieved in L (720.27 ± 153.22 kg/ha), which was significantly different from DD and P. My result is in line with the result reported by Goulart et al., (2021), who indicated that high yield is obtained in L tillage treatment. According to Pashchenko et al.,(2019), the grain yield was greater across all subsurface treatment variations compared to the control. The alternatives for subsurface tillage to a depth of 40 cm produced the maximum yield. Progress and advancement are promoted by sub-soiling tillage methods, which also produce a little more grain than ploughing. W. Wang et al., (2022) According to Haile, the yield of the inter-row subsoiling method was higher compared to the yield of the absence of subsoiling method. In comparison to absence of between row subsoiling, the between row subsoiling treatment resulted in an initial sprouting duration, a greater rate of germination, plus greater plant matter collection. Similar result was reported by Pinar & Yilmaz, (2008) Only the subsoiling treatment had statistical significance for the yield parameter (p<0.01), and its presence increased the output. There were significant differences in yield among tillage methods. The traditional tillage technique showed a better yield in compared to no-tillage techniques. Sub soiling procedure significantly increased the parameters of plant growth, yield characteristics, and soybean yield relative to other cultivation methods (Ozturk & Sogut, 2016).

5. Conclusion and Recommendation

The study's findings showed that tillage treatments significantly affected plant density, number of pods, number of seeds, and yield. Plant density and the number of pods were significantly impacted by the type of ploughing. Based to the mean results from the study's results, loosening had an extremely substantial impact on both the number of seeds and the final yield produced by the crop. The study's findings, which were based on experiments with various tillage methods, indicated that tillage practices had a detrimental impact on seed output. Regarding yield, there are considerable variations among tillage techniques. In comparison to direct drilling and ploughing techniques, there was a higher yield identified in loosening tillage. Ploughing offers the highest plant population in terms of production potential, plus the development of additional lateral branches may make up for the anticipated decline in output caused by the fewer plants.

The findings of this research, which was carried out under various types of tillage's, show that tillage techniques had no detrimental effects on the water content of the soil. Regarding soil moistness, there were little variations among tillage techniques. Direct drilling, Loosening and ploughing tillage treatments had significant ($p<0.05$) effect on soil penetration resistance at depth between 15-30 cm, and depth between 30-50cm and agronomic structure or soil fractions (clod% crumb%, and small crumb %).In the contrary the different tillage treatments were insignificant ($p>0.05$) effect on soil penetration resistance at depth between 0-15 cm, soil moisture content at the following depths between (0 -15 cm, 15- 30 cm, 30 – 50 cm) and dust % fraction which are determining for the soybean yield. Tillage treatments had a substantial ($P< 0.05$) impact on the quantity of plants, pods per plant, seeds per pod, and seed yield, with the impact of tillage on yield being particularly noteworthy ($p< 0.01$).Only loosening/sub soiling exhibited worthy important on seed yield characteristics and encoded the maximum amount of seeds each plant. The amount produced is increased by subsoiling treatment. Thereby, loosening is appropriate for soybean production.

Farmers frequently find it difficult to make soil of appropriate quality to growth due to climate and state of technology. During the time of sowing, soybean needs soil that is adequately solid, crumbly but not dusty, and loose enough in the range of 28 to 35 cm. It is able to develop and erupt in such fashion, which additionally dictates how much is produced and how profitable it is to cultivate. By the conclusion of the study, the results showed that the average clod percentage in direct drilling and ploughing experiments had increased over 100%. Thus, it was concluded that direct drilling treatment and ploughing treatment contributed to hazardous clod formation. This could be the outcome of ploughing at not enough moisture in the soil levels. Tillage at an identical depth every year boosts the probability of condense layers forming within the soil because the utilized methods of land activities influence the soil structure through time. Consequently it is recommended to adopt soil structure protecting tillage approaches and change the cultivation depth from season to season. According to my research result loosening tillage system is profitable to use in soybean production in temperate zone with sandy loam type of soil. Since the research site was at Godollo (Hungary) in sandy loam which was highly degraded poor soil and there was extreme drought condition. However loosening tillage method scored higher grain yield of soybean than direct drilling and ploughing tillage's treatments.

Summary

Thesis title: **Assessing the Impact of Primary Tillage on Soybean**

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Course: MSC Crop Production Engineering

Institute/Department: Agronomy

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Different tillage systems have impact on the soybean yield. Therefore this research conducted to evaluate how different tillage tactics act on soybean growth and yield feature, under different primary tillage techniques .which means loosening, ploughing and direct drilling tillage systems Soybean *(Glycine max* (L.) Merr.) Is one from the significant legume crops in terms of its protein composition world-wide? The research was aimed at achieving the effects of different tillage techniques on soybean grain yield and on the physical characteristics of soil state in field conditions, with an emphasis on the agronomic structure, penetration resistance, and moisture content of the soil that affects the yield of soybeans.

. The primary research area was the soybean cultivation method and possible approaches for raising yields in Hungary. Because it has served as both humans' plus livestock' main sources of amino acids as well as oil. Production and yield have not greatly risen over the years, although having enormous implications for the country's economic well-being and availability of food. The research work was conducted at Száritópuszta, Gödöllő town of Hungary. Experiment was conducted in a Random Strip Design with three tillage treatments were replicated three times. During The experiment the following parameters were measured. They are:- soil penetration resistance between(0 – 15 cm, 15 – 30 cm and 30 – 50 cm) using penetrometer (MPa).Soil moisture content at the depth between (0 – 15 cm, 15 – 30 cm and 30 – 50 cm) using Tensiometer (m/m %).Agronomic structure (clod %, crumb %, small crumb% and dust %) by using different size of sieves(>10 mm,2.5- 10mm,0.25-25mm and < 0.25 mm) also measured and plant parameters such as plant density in m^2,number of pods/plant, number

of seeds/pod and grain yield in kg/ha were recorded. Multivariate Anova was used to analyse the effects of every treatment used on soybean at the level of 0.05 of probability and LSD tests using the SPSS software were used to analyse the significant difference between tillage for each treatment. The research result showed that Loosening had statically highly significant effect at the ($p<0.05$) level on soybean grain yield. Furthermore the study's findings showed that tillage treatments significantly affected soil penetration resistance between 15 -30 cm and 30 -50 cm, plant density, number of pods, number of seeds, and yield. Whereas the different tillage treatments were insignificant ($p>0.05$) effect on soil penetration resistance at depth between 30 - 50 cm, soil moisture content at the following depths between (0 -15 cm, 15- 30 cm, 30 – 50 cm) and dust % fraction which are determining for the soybean yield.

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Declaration

STUDENT DECLARATION

Signed below, **Zerabruk Atakli Abraham**, student of the Szent István Campus of the Hungarian University of Agriculture and Life Science, at the MSc Course of

Crop Production engineering, declare that the present Thesis is my own work and I have used the cited and quoted literature in accordance with the relevant legal and ethical rules. I understand that the one-page-summary of my thesis will be uploaded on the website of the Campus/Institute/Course and my Thesis will be available at the Host Department/Institute and in the repository of the University in accordance with the relevant legal and ethical rules.

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As primary supervisor of the author of this thesis, I hereby declare that review of the thesis was done thoroughly; student was informed and guided on the method of citing literature sources in the dissertation, attention was drawn on the importance of using literature data in accordance with the relevant legal and ethical rules.

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