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The role of cover crop and minimum tillage in the soil quality: Review

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Abstract:

The management of cover crops is one of the classic agricultural strategies and is now receiving global attention. cover crop include plant species that used for reason beyond primary grain, or the forage productions, often categorized as leguminous broad leave, non-leguminous broad leaves, or the grasses. According to the Soil Science Society of America (SSSA), CCs used to safeguard, and enhance the soil through intervals of annual crop cultivation or between trees in orchards and vines in vineyards. Proper managements are required to realize several benefits associated with cover crops. Effective cover crops need meticulous planning and the selection of suitable types, seeding rate, planting periods, termination stages, and termination procedures. Among the management techniques, species selections, termination stages, and terminations strategies are identified as the most crucial elements for optimizing cover crops to provide numerous advantages while preventing nutrient immobilizations, and competition with the subsequent cash crop. Integrating crop residues with tillage practice is an advantage by adding organic matters, and carbon the soil which is a prerequisite for better physical, biological and chemical properties. Leaving crop residues on the soil surface reduces its apparent density and compaction. It has been found that the value of water conductivity is greater in the case of no-tillage compared to the ploughed soil due to the greater number of large plants and increased microbial activity. Incorporating crop residues into soil increases the rates of water conductivity saturated, and regulating soil temperature.

Keywords*: cover crops, minimum tillage, soil quality*
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دور محاصيل التغطية والحراثة الصغرى في جودة التربة: مراجعة

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الخلاصة:

تعد إدارة محاصيل التغطية إحدى الاستراتيجيات الزراعية الكلاسيكية وتحظى الآن باهتمام عالمي، وتشمل محاصيل التغطية أي أنواع نباتية تستخدم لأسباب تتجاوز إنتاج الحبوب أو العلف الأولي، وغالباً ما تصنف على أنها أوراق عريضة البقوليات أو أوراق عريضة غير نباتية أو أعشاب. ووفقًا لجمعية علوم التربة الأمريكية (SSSA)، تُستخدم محاصيل التغطية لحماية التربة وتعزيزها بين فترات زراعة المحاصيل السنوية أو بين الأشجار في البساتين والكروم في مزارع الكروم.

الإدارة السليمة مطلوبة لتحقيق العديد من الفوائد المرتبطة بمحاصيل التغطية. وتحتاج محاصيل التغطية الفعالة إلى تخطيط دقيق واختيار الأنواع المناسبة ومعدلات البذر وفترات الزراعة ومراحل الإنهاء وإجراءات الإنهاء. ومن بين تقنيات الإدارة، تم تحديد اختيار الأنواع ومرحلة الإنهاء واستراتيجيات الإنهاء باعتبارها العناصر الأكثر أهمية لتحسين المحاصيل الغطائية لتوفير العديد من المزايا مع منع تجميد المغذيات والتنافس مع المحاصيل الاقتصادية اللاحقة. يعد دمج مخلفات المحاصيل مع ممارسات الحرث ميزة من خلال إضافة المواد العضوية والكاربون إلى التربة وهو شرط أساسي لتحسين الخصائص الفيزيائية والبيولوجية والكيميائية. يؤدي ترك مخلفات المحاصيل على سطح التربة إلى تقليل كثافتها الظاهرية وضغطها. وقد وجد أن قيمة توصيل المياه أكبر في حالة عدم الحرث مقارنه بالتربة المحروثه بسبب العدد الاكبر من النباتات الكبيره وزيادة النشاط المايكروبي. كما يؤدي دمج مخلفات المحاصيل في التربه إلى زيادة معدل الايصالية المائيه المشبعة و تنظيم درجة حرارة التربة.

الكلمات المفتاحية: *المحاصيل الغطائية، الحراثة الدنيا، جودة التربة.*

Introduction

Organic matter is animal waste, plant tissue such as twigs, leaves, and other plant parts, if it is completely decomposed and it is difficult to distinguish the sources or incomplete decomposition, infinitives can be identified, but plant tissue or animal waste, as well as there are organic nouns, but solid, such as poultry waste. Cows, sheep, and other wastes, even plant wastes, exist in solid form as well as in liquid form. Also, the necessity of using organic plant fertilizers to reduce the effect of soil salinity and irrigations with the water, to preserve the vitality of soil organisms, and to increase the ability to resist the effect of salinity.

Cover crops :Cover crops matter is added to the soil, regardless of whether it is of vegetable or animal origin, because these wastes are a source of nutrients, organic acids, fungi, and organic matter, and the difference in the ratio of nutrients from organic fertilizer to the latter, regardless of whether it is vegetable or animal (Sharma et al., 2018; Ti et al., 2023). As a result of the difference between vegetable waste and animal waste in most of the qualities and percentage of elements, many of my researches have recommended adding vegetable waste with animal waste in the process of fermentation and decomposition to increase the efficiency of this process, because animal waste, especially poultry waste, contains a high amount of nitrogen and low carbon in it, so all the waste with vegetable residues to obtain the appropriate C/N ratio and increase the stability of the fertilizer (**Delgado *et al.*, 2021**; **Ati *et al.*, 2016; Kaye and Quimada, 2017**).

Decomposing vegetable and animal wastes are the primary source of organic fertilizers, which are decomposed in air or air, so that we cannot call them organic fertilizers. Moreover, they must be characterized by certain characteristics, such as the disappearance of the characteristics of the original material, whether it is vegetable or animal, and the transformation of complex compounds into simpler compounds that plants can use. The decrease in C/N ratio is important because it increases the ability of the soil added to it to retain water and nutrients and increase the vitality of the living organisms. The ratio of carbon in the soil and the increase in the exchange rate of soil added. The increase in the grain yield is the result of the addition of these fertilizers in addition to the provision of plant nutrients in appropriate quantities and at all stages of growth (**Novara *et al.,* 2021**). Cover crop can be performing multiple function in an the agricultural ecosystems simultaneously. They are planted for purpose of preventing soil erosions (**Beniaich *et al.*, 2020**).

The soil quality has managed to produce optimum condition for the crops to thrive. The main factor of soil quality is the soil salinity, the pH, the microbial balance, and the prevention of soil (**Ati, 1999; Upadhyay *et al.* 2020**). Cover plant are one of the most important sources of nutrient supply to crops because they supply phosphorus and potassium in the near future, but as time progresses, they supply nitrogen, potassium, sulfur and other elements such as trace elements. As a result, the demand for organic fertilizers increased significantly and the production of organic fertilizers increased by 33% for the period of 2003-2013, and the

production reached about 5 billion micrograms, and the Asian market had a large share of the production, reaching about 47% of the total global production. First, the United States with 29%, but Europe came third with 16%, but Africa achieved the percentage 6% of global production overview (**Weyers *et al.,* 2021**). The growth of the crop root results in formations of soil pores, that provide pathway for water to infiltrates through soil matrix rather than draining the field as surface runoff with increase water infiltrations, the potential for the soil water storages, and groundwater recharges could be improved (**Sandoval and Tiburan, 2019**).

Meyer et al., (2020) generally pointed out that organic matter works to reduce the apparent density of the soil and therefore increase the ability of plant roots to grow and increase densities, especially when adding plant organic matter as organic fertilizers. **Mubvumba et al., (2021)** concluded Organic fertilizers improve the structure of the soil and increase the ability of the soil to retain nutrients, as well as the loss of washing and drying and resistance to drought. Especially in Al-Jafah and Sub-Al-Jafah areas as a result of its high capacity to hold and retain large amounts of moisture and increase water content in the soil. They pointed out that chemical fertilizers alone are not enough to achieve the required production, but the addition of organic fertilizers ensures the highest production in some regions. The addition of organic fertilizers to the soil contributes to increasing the exchange capacity of positive ions and reducing the degree of soil reactivity, as well as increasing production and improving its quality (**Meyer *et al*., 2020**; **Mubvumba *et al*., 2021**).

Romdhane et al., (2019) obtained a significant increase in chlorophyll, leaf area, plant height, and dry matter, as well as yellow corn grain yield when poultry waste was added to the soil before planting, as well as Aziz et al. When adding poultry waste with some farm waste to the soil planted with the crop at the level of 10 µg/ha^{-1}. **Qu et al., (2019)** also confirmed the superiority of the processes in which fermented poultry waste is used over most other organic wastes, whether fermented or non-fermented, due to the difference of these wastes in the availability of nitrogen, phosphorus, and potassium in the soil and concentrations in plant tissue, as well as an increase in dry matter yield and grain yield.

Also, obtained results indicating the superiority of the operations in which fermented poultry offal was used over the rest of the operations in grain yield and the proportion of major nutrients in the plant for the sunflower yield. Cover crop is used to enhance, and protect of the soil. They could serve as either lives, or dead mulch on soil surface. They could be incorporated into soil as green manures. According to definition provided by Soil Science Society of America (SSSA), cover crop is defined as "close growing crop that provides the soil protections, and soil improvements between period of normal crop productions, or between tree in orchard, and vines in vineyard. Cover crop may include several plants types, mostly legume, or the non-leguminous grasses (**Scavo *et al*., 2022; Al-Lami *et al.,* 2023 a,b; Ati and Dawod, 2024).**

The Tillage is an agricultural practices which aim to prepare agricultural soil by move ,and turning mechanically, and different kinds of plowing processes were used in the plowing process, depending on goal of tillages. **ACSAD (2011); Ati *et al*. (2014 a,b); Ati *et al*., (2020); Alwazzan and Ati (2024); Dawod *et al*., (2024)** showed that an increase in the amount of available phosphorus in the soil when adding humic acid, but it was significant at the level of 0.2% of soil weight, so the amount of available phosphorus was 4 mg P kg^{-1} soil. As humic acid is an important source of energy for micro-organisms and increasing their activities and abilities to increase the availability of some elements, especially micro-nutrients, as well as forming chelating compounds makes the phosphate ion free and more ready to be absorbed by the plant. However, found in their results a significant increase in the amount of available phosphorus in the soil when adding humic acid at different levels. Also, found an

increase in the percentage of available phosphorus in the soil for the full maturity stage when planting yellow corn and using different levels of oleic acid.

As well as, tillage found during their experiments to test four Spanish-made organic fertilizers that there are differences between them in the percentage of components and in their results when growing rice crops with in two consecutive seasons, and is superior in most of the characteristics of the two cultivars of rice and all seasons. The other three fertilizers and the reason for this is that this fertilizer contains the highest percentage of organic matter and the concentration of elements The major nutrients in this fertilizer are also superior because it is used for spraying on the soil and several times during the growth stages, so the fertilizer works to improve the physical and chemical properties of the soil, as well as improve the growth containers and increase the effectiveness of microorganisms and reduce the harmful effects of soil salinity or irrigation water and quality.

Minimum tillage considered to the one of the types of tillage, which leave partials residues of former plants at a rate of 15-30%. The most important feature of systems are that retains soils moistures, and organic matter contents. Also, protect soil from winds, and water erosions, maintain soil fertility and improve its quality, and reduce productions costs (**Krauss *et al.*, 2020; Ati *et al*., 2017; Hassan *et al*., 2023; Ati *et al.*, 2024 a, b; Ayada *et al*., 2024**).

The modern and advanced methods in agriculture is considered the only factor that improves plant growth and productivity, and it must also coincide with the selection of genetic combinations planted in Iraqi conditions, which may be different in their response to crop maintenance operations and other growth requirements, which may reflect on the grain yield as well as on the density of the dry matter in the plant **(Jena, 2019)**, and that the genetic combinations differ in their responses depending on the genetic ability of the combination. Genetics, which includes the delivery of manufactured food from the source to the source, and therefore, the choice of genetic composition, which can give high productivity, also represents the other direction after the operation of the crop and soil service **Jassim et al. (2017)** and one of the main reasons for the large difference in the average yield between Iraq And the world may be the result of the lack of use of high-productivity genetic combinations that are suitable for the Iraqi environmental conditions, in addition to the lack of availability of genetic combinations that may have heritability. originality to obtain excellent production when the production and management factors are available.

Reduce Tillage has described as sustainable agricultural practices for increase land productivities. There are growing interests in applications in developing countries. The developed countries are successfully implemented minimum tillages, increased plants yield, improved germinations condition, and emergences of seedling, improve physical, chemical, and biological quality of the soil, and created better condition for the growth and productions. **Al-Hadithi (2019),** recently, there are particular interests in system with least tillage to reduce cost of field crops productions, and improve the soil condition. Compared with the traditional farming, systems have several benefits, the most prominent of which may be reductions of the time required for farming, and the reductions of the use of machines, thereby saving fuels, reduce costs, reduce workload and improve growth of the field seedling, and increase the productivity of crop. **Conyers *et al.* (2019)** are reported that minimums tillage increasing the chance of planting crops on the time, especially in rainy season, and reducing soil compactions by machinery. **Githongo (2021)** in Lithuanian soil on success of the minimums tillage, it indicated that use of minimums tillage in mixed soils was successful, efficient, and least expensive than conventional tillages. **Jin (2021)** has reported that the using tillage systems enables to the invest millions of hectare of the land in sloping areas that can not be cultivate currently due to erosion concern, therefore increasing the available for crop productions.

Conclusions

The study concludes that cover crop methods, which minimizing evaporations, and thus reduce the amount of water that added. The studies recommends that use of minimums, or reduce tillage as it is positive effects on the soil's physical property, and increasing productions.

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