# A Research on Investigation of the Application Possibilities of Direct Drill Machine with Liquid Fertilizer Assembly for Grain Planting Stubble*

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## ABSTRACT

In this study, it is aimed to develop a direct drill machine, which can sow directly without cultivating the soil after the sunflower harvest in the Thrace Region, by applying liquid fertilizer, instead of the granular fertilizer used in the current sowing machines, and applying liquid fertilizer with sowing. The field work of the grain sowing machine directly to the sunflower stubble with liquid fertilizer device was developed in Altayoglu Agricultural Machinery Food Agriculture and Farmer Ind.Ttrade.Co.Ltd. and It was carried out in the production areas of the company. The performance of the direct drill machine was determined from the vegetative and generative characteristics of the sowed plant length, plant wet root weight, plant height, spike length, grain weight in main spike, thousand grain weight and yield values. Liquid fertilizers applied directly by grain direct drill machine effect on wet root weight, spike length, grain weight in main spike and thousand grain weight were found to be statistically significant. However, the effect of applied liquid fertilizer applications on plant length, spike length, and yield was found to be statistically insignificant. Among the liquid fertilizers applied at the same dosages, the highest yield was found to be 646.91 kg/da in liquid fertilizer B and the lowest yield was 593.07 kg/da in conventional method.

***Keywords:***Cereal, Direct drill, Liquid fertilizer, Wheat, Sunflower, Sowing machine

## I. INTRODUCTION

Agricultural management practices that produce economic crop yield while improving soil health are the keys for sustainable production systems [1]. While there is research documenting benefits of conventional tillage (CT), including field workability, weed suppression, and crop productivity, other research shows that CT reduces soil biodiversity, degrades soil structure, accelerates soil organic matter (SOM) loss, affects reactive nutrient cycling, and consequently, diminishes soil health [1], [2], [3]. The reactive nitrogen (N) and phosphor (P) fertilizers applied with CT are responsible for reduced agroecosystem services.

In recent years, irregular rainfall events caused by global warming have caused droughts to intensify.Therefore, conserving water in the soil and reducing energy costs has become a priority in agricultural production.For this purpose, reduced tillage and no-tillage methods in agricultural production have become widespread in developed countries in recent years. These techniques increase the organic matter content in the soil, reduce the density of the soil due toless fieldtraffic, and

minimize water and wind erosion because direct cultivation methodsleave more plant residue on the surface.

Fertilizers falling on the soil together with the seeds in the mentioned precision sowing machines manufactured in the current technique are in granule or micro granule form. In this case, said granular fertilizers in the structure, the development of the seedtoxicto act and push the root of the effects of germination in terms of water uptake to be able to.The mentioned granular fertilizers can also damage the microorganisms in the soil.

The liquid fertilizer spreading system, which is a new system that can be an alternative to the granule fertilizer system in existing seeders, was placed on the machine, and the applicability of a new machine that can both directly sow and have liquid fertilizer disposal feature was investigated. In this study, it is aimed to examine the application possibilities of direct sowing machine with liquid device that can directly sow without cultivating the soil in grain sowing after sunflower harvest in Thrace Region. Theplant wet root weight, plant height, spike length, grain weight in the main spike, thousand kernel weight and yield values were determined from the vegetative and genarative characteristics of the performance of the direct seeder.

## II. MATERIALS AND METHODS

### 2.1.Material

#### 2.1.1. Direct drill machine with liquid fertilizer

The design and production of the sunflower stubble direct grain planter with liquid fertilizer device, which constitutes the main material of this research,was carried out in the Altayoglu Agricultural Machinery Food Agriculture and Farmer Ind.Ttrade.Co.Ltd. (Figure-1).Theliquid fertilizer system of themachineis given in Figure-2and its general dimensions are given in Table-1.

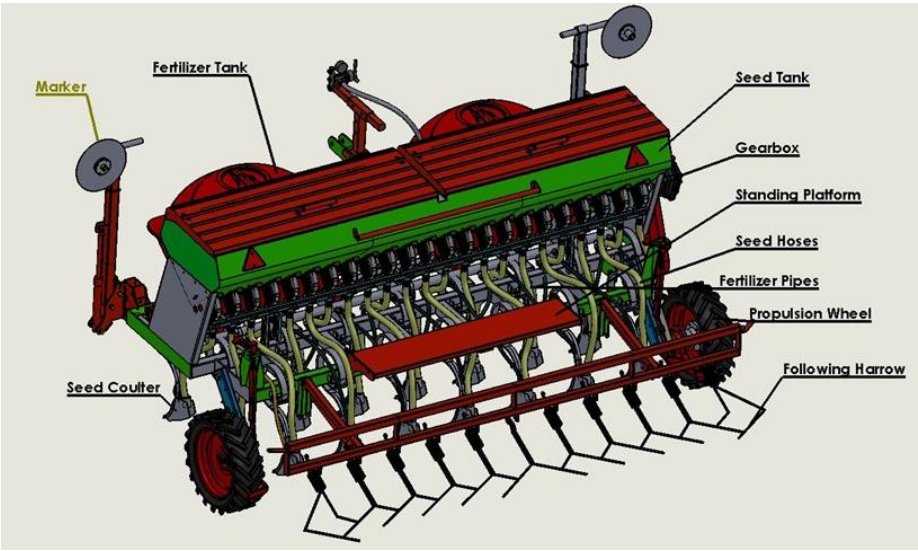


Figure 1. Direct drill machinery with liquid fertilizer systems

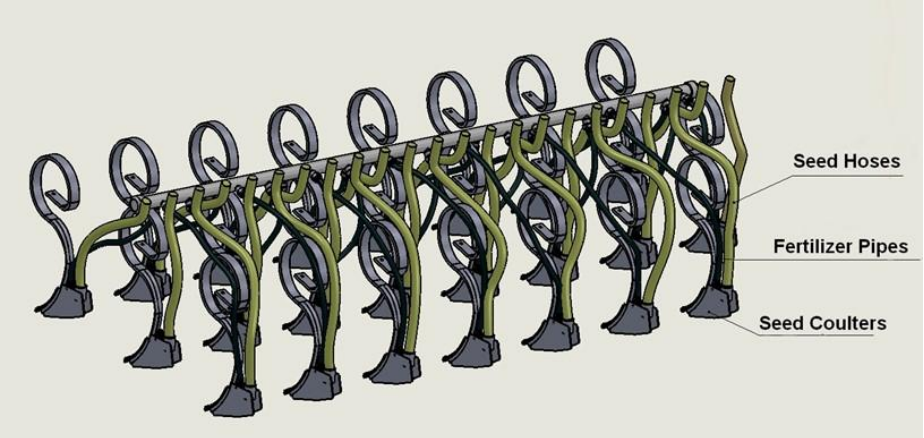


Figure 2.The liquid fertilizer system of the mulch direct grain planter

Table-1 General dimensions of the driect drill machine

| General Dimension | Road Position | WorkingPosition |
|---|---|---|
| Length (mm) | 2400 | 2400 |
| Width (mm) | 3250 | 5650 |
| Height (mm) | 1750 | 1500 |
| Weight(kg) | 880 | |
| Workingwidth (mm) | 2375 | |
| OperationSpeed (km/h) | 5-7 | |
| Powerrequired (hp) | >95 | |
| 3 PointLinkageCategory | Category-II | |
| Number of openerseedbed | 19 | |
| Openertype | Spring Type | |
| Distancebetweentheseedcoulters (mm) | 125 | |
| Grain tank capacity (liter) | 373 | |
| Fertilizer tank tapacity (liter) | 393 | |

**2.1.2.Site description**

Field trials of this study were carried out Tekirdağ Province, Hayrabolu District, İlyas District during the 2019-2020 production season.Within the borders of Tekirdağ Province, Hayrabolu District is located between 41° 12′ 47″ north and 27° 6′ 24″ east longitudes. Hayrabolu district is 60 meters above sea level.The location of the field where field trials are conducted is between 41° 20′ 74″ north and 27° 06′ 47″ east longitudes.

The soil in the experiment field was a clay soil with a texture of 35,22% clay, 34,03% silt and 30,75% sand, well drained and the available waterholding capacity within 1.20 m of the soil profile isapproximately 0.18 m [4]. Field capacity was %39,72 and infiltration rate was 10,45 mm/h.

The climate of Hayrabolu is characterized by Mediterranean type with mild and rainy winters and hot and dry summer at the coast while continental type prevails inside.

**2.1.3. Features of the wheat variety**

TheEnola variety, whichis mostlypreferred in clay-silt and sandysoilsin the Thrace Region, was used as plant material in the experiment.It is a kind of white spike with awn, ears are long and semi-inclined structure.Plant height is 80-85 cm. Its grain is very large, red in color and hard-semi-hard structure, it is a medium early variety. It is a very strong variety, high yielding, high quality,

resistance to diseases, frost and drought.It is recommended to be planted in all kinds of soil structures and its yieldpotential varies between 450-850 kg / da. The amount of seed to be used varies between 20-22 kg per decare (Anonymous, 2019)

**2.1.4. Properties of liquid fertilizers**

In the field trials of the direct seed drill, four different liquid fertilizers available on the market were used only during planting. Different carriers widely used in Turkey fluid produced fertilizers A, B, C, D encoded and the traditional method used in wheat farming in the Thrace Region is shown as GLN. Liquid fertilizers used in the study are organic matter 20%, total nitrogen 2%, water soluble potassium oxide (K2O), free amino acid 1%, maximum EC 4 (dS/ m) and pH between 5 and 7%.

**2.2.Method**

**2.2.1.Plant Characteristics Measurements**

In the experiments, the spraying was done against weeds at the appropriate period, and the application of nitrogen fertilizer (5 kg pure phosphorus) over 15 kg / ha, kg pure nitrogen was applied in 2 periods, at the beginning of the stem and before the heading.The following measurements and observations were made on the plants in the plot in the field during the trial.

*Wet root weight:* After the plants are harvested, the soil on the roots will be washed away and then weighed in gram after being kept in the shade between twopapertowelsto remove the water [5].

*Plant height:*Ten plants randomly selected from each plotwere averaged by measuring the distance between the root collar and the top of thespikeand the plant height was recorded in mm[5].

*Spike length:*Ears on the main stem of 10 plants randomly selected from each plot were measured and averaged, the spike length was found in mm[5].

*Kernel weight in the main spike:* The grains in the main ear of the plants taken randomly from each plot were weighed and averaged and determined as gram[5].

*Thousand grain weight:*Four seeds from each of the harvested parcels will be randomly taken from 100 seeds, weighed separately, averaged and converted to 1000 grain weight and determined in grams [5].

*Yield:* In order to determine the effects on the yield of liquid fertilizers used in different types, the yields (kg/da) were determined by harvesting the plants in 1 $m^2$ in the middle parts of the plot in three replications during the harvest period[5].

**2.2.2. Application Norms of Fertilizers**

In the experiment, 4 liters of liquid fertilizer was applied per hectare during planting in liquid fertilizer applications.The traditional method is that 20 kg of NPK (20-20-0) chemical fertilizer is laid per decare during planting. After planting, 46% Nitrogen (20 kg / da) was given as the second fertilizer in all applications, and 20 kg 26% Ammonium Nitrate ($NH_4NO_3$) fertilizer was given per decare in the third application.

**2.2.3.Statistical analysis and experimental design**

A randomizedcompleteblockdesign (RCBD) withthreeblockswasused in thisexperiment. Eachblocktaken as treatment had threeplotsconsisting of threereplications (Figure-3). One-wayanalyses of variance (ANOVA) wereperformedusingSPSS software (Version 12:00; Chicago, IL, USA). Duncan'sMultipleRange Test at $p \leq 0{,}005$ wasusedtocomparethemeans of theobtainedresults in thisresearch(Düzgüneş et al. 1987).

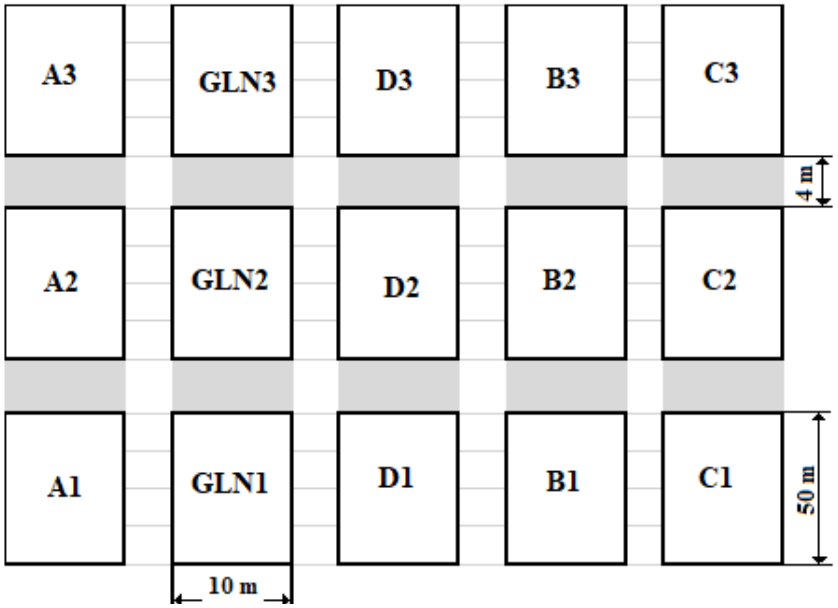


Figure-3. Experimental design for liquid fertilizer applications

## III. RESEARCH RESULTS AND DISCUSSION

### 3.1. Wet root weight

The difference between the values related to the wet root weight according to the liquid fertilizer types appliedwas found to be significant as statistics. The maximum wet weight of B fertilizer, which is one of the liquid fertilizer producers, was determined in the traditional method with thesame dose of 7.30 grams and at least 4.53 grams (Table-2).When the wet root weights were examined, liquid fertilizers given during plantinghad a positive effecton the germination of the plant and the development of the roots. Thirumaran et all. (2009) compared liquid fertilizer applications with chemical fertilizer applications.According to the results, they found that liquid fertilizer applications increased the length of the plant roots. With this study, liquid fertilizer application also had a positive effect on root weight.

Table-2.Descriptive statistics on damp root weight

| Liquid Fertilizers | Mean ± SS | S Error | Min | Max | P |
|---|---|---|---|---|---|
| A | 5,07±0,38ab | 0,22 | 4,8 | 5,5 | 0,000 |
| B | 7,30±0,53a | 0,31 | 6,9 | 7,9 | |
| C | 5,67±0,57a | 0,33 | 5,2 | 6,3 | |
| D | 5,50±0,26a | 0,15 | 5,2 | 5,7 | |
| GLN | 4,53±0,21b | 0,12 | 4,3 | 4,7 | |

*Values with the same letter are not significantly different at the 0.05 levels.

### 3.2. Plant height

In the experiments, the differences between the methods applied in terms of plant height were found insignificant.However, the highest effect on the plant heightwas obtained in theapplication of B fertilizer and the least effect on the plant height was obtained in theapplication of A fertilizer(Table-3).Liquid fertilizer types and traditional methods have the same effect on plant height.Matsi et al. (2003) determined that liquid fertilizer applications did not affect seed germination in their study.

Table-3.Descriptive statistics for plant height

| Liquid Fertilizers | Mean ± SS | S Error | Min | Max | P |
|---|---|---|---|---|---|
| A | 738,33±31,34a | 18,10 | 712,0 | 773,0 | |
| B | 802,00±58,62a | 33,84 | 736,0 | 848,0 | 0,738 |
| C | 766,00±100,64a | 58,11 | 653,0 | 846,0 | |
| D | 783,00±115,52a | 8,96 | 768,0 | 799,0 | |
| GLN | 742,33±84,44a | 18,75 | 645,0 | 796,0 | |

*Values with the same letter are not significantly different at the 0.05 levels.

### 3.3. Spikelength

The effect of liquid fertilizer applications on spike length, which is effective on yield, was found to be statistically significant.The maximum spike length was obtained from Bfertilizerwith 98.83 mm and at least 82.23 mm in traditional method (Table-4).The effect of other fertilizers A,B,C, and D fertilizers on the spike length was the same (Figure-4).

Table-4. Descriptive statistics for spike length

| Liquid Fertilizer | Mean ± SS | S Error | Min | Max | P |
|---|---|---|---|---|---|
| A | 89,13±13,49ab | 7,79 | 80,9 | 104,7 | |
| B | 98,83±10,37a | 5,99 | 92,6 | 110,8 | 0,208 |
| C | 85,93±4,29ab | 2,48 | 82,7 | 90,8 | |
| D | 88,13±2,81ab | 1,62 | 84,9 | 90,0 | |
| GLN | 82,23±2,16b | 1,25 | 80,7 | 84,7 | |

*Values with the same letter are not significantly different at the 0.05 levels.

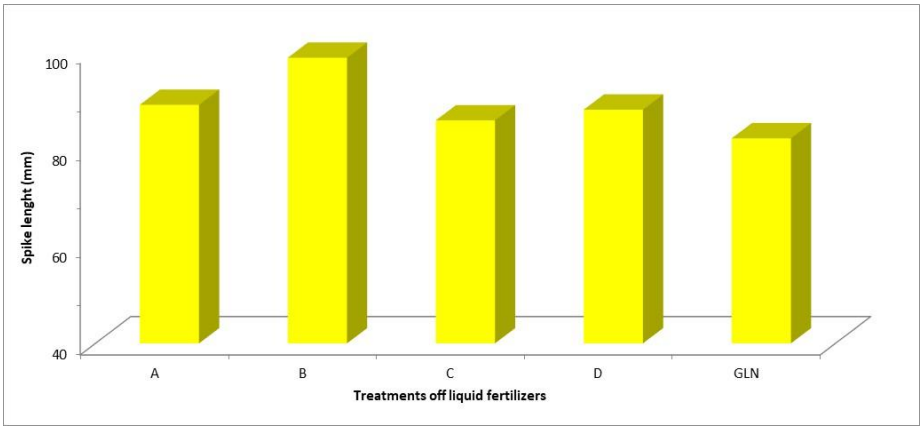


Figure-4.The effect of liquid fertilizers on spike length

### 3.4. Grain weight in main spike

As a result of the statistical analysis made in terms of the grain weight in the main spike, which is one of the parameters affecting the yield,it was determinedthatthedifference between fertilizersis important.The results descriptive statistics for the difference is not significant (Table-5).Liquid fertilizer applications were found in the same group and the maximum spike length was in B fertilizer with 1.90 grams, while the traditional method was in a different group and the grain in the spike was found to be 1.44grams (Figure-5).Armstrong et al.(1993) found in a study they conducted in Russia that liquid fertilizers increased the seed weight in the spike [10]. Nankova et al.(2004), in their study, it has been observed that cereals tend to be more willing to apply liquid and equivalent solid fertilizers during the vegetation period and tend to increase the growth rate [11]. Similar results were

obtained in this study.As a result of liquid fertilizer applications, it had a positive effect on grain weight in the main spike.

Table-5.Descriptive statistics for grain weight in main spike

| Liquid Fertilizer | Mean ± SS | S Error | Min | Max | P |
|---|---|---|---|---|---|
| A | 1,84±0,056a | 0,03 | 1,8 | 1,9 | |
| B | 1,90±0,06a | 0,03 | 1,9 | 2,0 | 0,014 |
| C | 1,65±0,28ab | 0,16 | 1,4 | 2,0 | |
| D | 1,82±0,09a | 0,05 | 1,8 | 1,9 | |
| GLN | 1,44±0,05b | 0,03 | 1,4 | 1,5 | |

*Values with the same letter are not significantly different at the 0.05 levels.

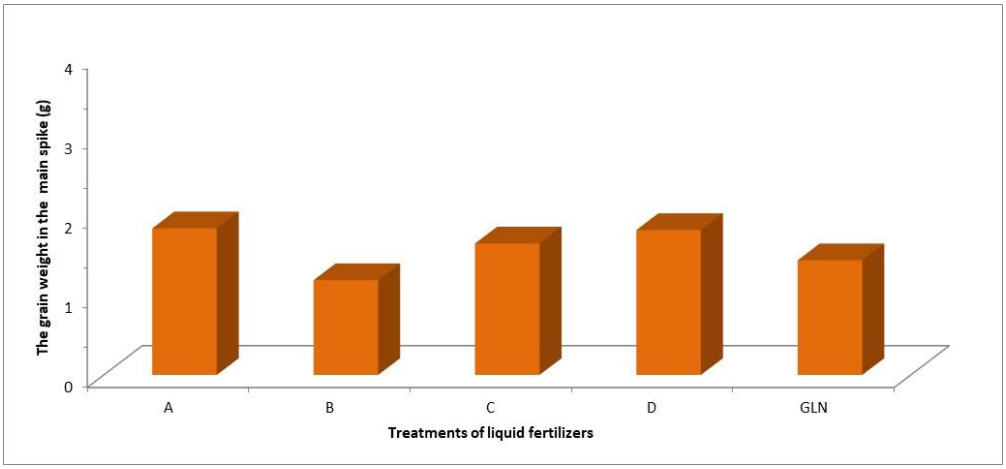


Figure-5. The effect of liquid fertilizers applied on the grain weight in the main spike

**3.5. Thousand kernel weight**

The results of thousand grain weights obtained, it was found that the difference between the applied methods is significant.Statistical data of the effectofliquid fertilizer types and traditional methods on thousand grain weight are given in Table-6.In this study, the highest thousand grain weight was obtained in the application of B fertilizer (41.96 g), and the least in the method where C fertilizer was applied (41.39 g).When the studies were examined, it was observed that similar results were obtained. Shahet al.(2013) found that it increased the weight of 100 seeds in a study they conducted.

Table-6.Descriptive statistics for thousand grain weight

| Liquid Fertilizer | Mean ± SS | S Error | Min | Max | P |
|---|---|---|---|---|---|
| A | 41,82±0,58a | 0,33 | 41,23 | 42,39 | |
| B | 41,96±0,38a | 0,21 | 41,56 | 42,32 | 0,457 |
| C | 41,39±0,17b | 0,09 | 41,24 | 41,57 | |
| D | 41,64±0,36b | 0,21 | 41,25 | 41,97 | |
| GLN | 41,59±0,29c | 0,17 | 41,38 | 41,92 | |

*Values with the same letter are not significantly different at the 0.05 levels.

**3.6. Yield**

The difference between the liquid fertilizer types whose effects on yield, which is the most important parameter, were examined, was not found to be statistically significant. Among the liquid fertilizers applied in the same doses, the highest yield was found in B fertilizer (646.91 kg/da), and the lowest yield was obtained in the traditional method (593.07 kg/da) (Table-7).

Table-7. Descriptive statistics for thousand grain weight

| Liquid Fertilizer | Mean ± SS | S Error | Min | Max | P |
|---|---|---|---|---|---|
| A | 633,51+56,67a | 32,72 | 569,4 | 676,9 | |
| B | 646,91+85,56a | 48,59 | 561,5 | 729,8 | 0,863 |
| C | 643,13+85,56a | 49,40 | 567,3 | 735,9 | |
| D | 624,40+51,61a | 29,80 | 565,0 | 658,3 | |
| GLN | 593,07+44,03a | 25,42 | 542,6 | 623,7 | |

*Values with the same letter are not significantly different at the 0.05 levels.

Liquid fertilizers given to the seed bed during the cultivation of grains had a positive effect onsome vegetative and generative characteristics of theplant.It was found that the effect of liquid fertilizers on the yield parameter, which is important in crop production, is not significant (Figure-6).When the liquid fertilizer studies were examined, they emphasized that the liquid fertilizer form has an important effect on plant root development. Matsiet al.(2003) found that liquid fertilizer applications did not affect seed germination, but did affect grain yield during the growth phase in a study they lay in.Shahet al.(2013) in a study of grain yield of 7.5% and 5.0% at concentrations. Empirical yield of 19% of the mother liquid manure, 74 and found that increased 3.16%. They emphasized that the increase in yield was due to increases in spike, spike weight, spike length and thousand grain weight[12]. Panayotova and Stoyanova (2014)hectare to 5 liters ofwaterIVfertilizer (maxgrow) application is a beneficial effect on yields compared to data they obtain in wheat cultivation, and they have determined (Panayotova and Stoyanova (2014) determined that IV fertilizer (maxgrow) application to 5 liters of water per hectare has a beneficial effect on the yield according to the data they obtained in wheat cultivation.) [13]. Similar results have been found and have also been identified by researchersin other studies [13-18].

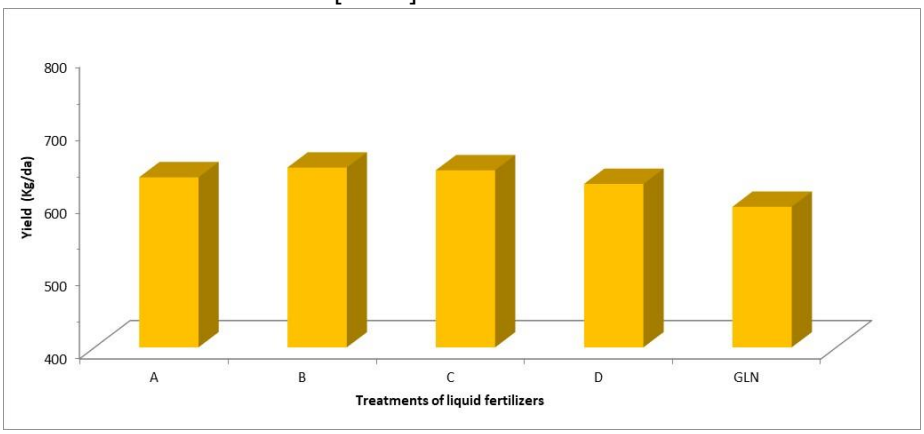


Figure-6. The effect of liquid fertilizers on the thousand grain weight

## IV. CONCLUSION AND RECOMMENDATIONS

The applicability of a direct sowing machine in agriculture has been investigated by placing a liquid fertilizer spreader device instead of granular fertilizer used in existing sowing machines, which can directly sow without cultivating the soil after sunflower harvest in the Thrace Region. The effects of the developed planter on the vegetative andgenarativecharacteristics of theplanted plant on theplant wet root weight, plant height, spike length, grain weight per spike, thousand kernel weight and yield values were investigated. As a result of the experiments, the following results were obtained.

1- The effect of liquid fertilizers produced in different types on the wet root weight of the plantwas found tobestatistically significant. The highest wet root weight was determined with B fertilizer with 7.30 g and with the traditional method with the lowest 4.53 g.

2-The liquid fertilizers applied had no effect on the plant height.With liquid fertilizer application, the highest plant height was obtained in B liquid fertilizer (802.00 mm) and the lowest plant height was obtained in A liquid fertilizer (738.33 mm) application.

3-It has been determined that liquid fertilizers arestatistically significant in terms of spike length.In line with the results obtained, more spike length 98.83 mm was obtained in B liquid fertilizer application and at least 82.23 mm in traditional method.

4- It was observed that the difference was statisticallysignificant interms of grain weight in the main spike.The grain weight in the main spike was found to be maximum 1.90 g in B liquid fertilizer, whereas the traditional method was 1.44 grams.

5- When the weight of thousand kernels was examined, it was found that the effect of liquid fertilizer applications was significant. The highest thousand grain weight was obtained in B liquid application with 41.99 g and the lowest in C liquid fertilizer application with 41.39g.

6- The effect of liquid fertilizer applications on yield wasstatisticallyinsignificant.Among the liquid fertilizers applied in the same dosages, the highest yield was found as 646.91 kg/da for B fertilizer and the lowest yield was determined as 593.07 kg/da in the traditional method.

Advantages of using direct drill machine with liquid fertilizer system in line with the results obtained;

- Preventstoxiceffects on seeds,
- Itprotects the seed against pests and diseases in theseedbed,
- Increasing the density of microorganisms in thesoiland thus increasing microbiological activities and increasing microbiological activity in the soil has a positive effect on productivity,
- Since the fertilizer is inliquid form, plant nutrients are more easily absorbed by plants,
- Byaccelerating the germination ofplants, the germination day is shortened.
- Provides the development of roots.
- Provides fuel savings.
- Stubbleroots hold the soil, reducing the damage of rainfall and wind to the soil surface.
- It prevents waterand wind erosion.
- It has eliminated the problem of soil compaction as the field traffic is reduced.

The disadvantages of using direct drill machine with Liquid Fertilizer System in line with the results obtained;

- Powerful tractors are needed to use the seed drill.
- Foreignincreasing weed density.

## References

[1] Crovetto, C.C. (2006) No-tillage: The relationship between no tillage, crop residues, plants and soil nutrition. Therma Impresores S.A., Hualpen, Chile.

[2] Sundermeier, A.P, Islam, K.R, Raut, Y., Reeder, R., and W. Dick, 2011. Continuous no-till impacts on biophysical carbon sequestration. Soil Sci. Soc. Am. J. 75: 1779-1788

[3] Aziz, I., Mahmood, T. & Islam, K.R. (2013) Effect of long-term no-till and conventional tillage practices on soil quality. Soil & Tillage Research 131: 28-35.

[4] Klute, A., Dinauer, R.C., Page, A.L., Miller, R.H., &Keeney, D.R.(Eds.), (1986). Methods of Soil Analysis. Part 1. Physical andMineralogical Methods, Agronomy Monograph 9, AmericanSociety of Agronomy, Madison, pp. 1182.

[5] Anonim, (2019). Tararun firma kataloğu, http://www.tararun.com.tr/index.php?tarar=tarar-urun&urun_id=19, Erişim Tarihi 19.04.2019.

[6] Okursoy, M.Y. (2006). Ekmeklik buğday genotiplerinin İN VİTRO ve N VİVO koşullarında kuraklığa dayanlıklık yönünden değerlendirilmesi (Yüksek Lisans). Trakya Üniversitesi, Fen Bilimleri Enstitüsü, Tarla Bitkileri Anabilim Dalı, Edirne.

[7] Düzgüneş, O., Kesici, T. & Gürbüz, F. (1987). İstatistik metodları-1. Ankara Üniversitesi, Ziraat Fakültesi, Yayın No:861, Ders Kitabı:229, Ankara.

[8] Thirumaran, G. Arumugam, M. Arumugam, R. &Anantharaman, P. (2009). Effect of seaweedliquidfertilizer on growthand pigment concentration of cyamopsistetrogonolaba (L) Taub. American-EurasianJournal of Agronomy 2 (2): 50-56.

[9] MatsiT.,Lithourgidis,A.S.&Gagianas, A.A. (2003). Effectsofinjectedliquidcattlemanure on growthandyield of winterwheatandsoilcharacteristics. Published in Agron. J., 95:592–596.

[10] Armstrong,J.Scott, Frank, B.P. Stan, D.P. ve Charles, C.R. (1993). TheEffect of planting time ınsecticidesandliquidfertilizer on therussianwheataphid (homoptera: aphididae) andthelesionnematode (pratylenchusthornei) on winterwheat. Journal of The Kansas EntomologicalSociety, 66 (1),:69-74.

[11] Nankova M, Ivanova, A. &Penchev, E, (2004). Characterization of liquid K-humaticlombricompostandpossibilitiestouse it during Tr. aestivum L. vegetation. FieldCrops Studies,1 (2); 292-299.

[12] ShahT.,Mukesh, Sudhakar, T. Zodape, Doongar Ram Chaudhary, KaruppananEswaran&JitendraChikara (2013). Seaweed sap as an alternativeliquidfertilizerforyieldandqualityımprovement of wheat, Journal of PlantNutrition, 36 (2): 192-200.

[13] Panayotova, G. &Stoyanova, A. (2014). Influence of universalliquidfertilizerMaxGrow on yieldandquality of durum wheat (Triticum durum Desf.) cultivarProgress. AgriculturalScienceandTechnology, Vol. 6, No 1, pp 50.

[14] Bayhan, Y. Kayisoglu, B. Gonulol, E.,Yalcin, H. &Sungur, N. (2006). Possibilities of directdrillingandreducedtillage in secondcropsilagecorn. SoilandTillageResearch, 88 (1-2):1-7.

[15] Karaağaç, H.A. & Barut, Z.B. (2007). II. ürün silajlık mısır tarımında farklı toprak işleme ve ekim sistemlerinin teknik ve ekonomik yönden karşılaştırılması. Tarımsal Mekanizasyon 24. Ulusal Kongresi, 5-6 Eylül 207, Kahramanmaraş.

[16] Bayhan, Y. (2015). İkinci ürün ayçiçeği tarımında doğrudan ekim olanaklarının araştırılması. Tekirdağ Ziraat Fakültesi Dergisi, 12 (1): 11-20.

[17] Sessiz, A. Alp, A. & Gürsoy, S. (2010). Conservationandconventionaltillagemethods on selectedsoilphysicalpropertiesandcorn (Zeamays L.) yieldandqualityundercroppingsystem in Turkey. BulgarianJournal of AgriculturalScience, 16(5):597-608.

[18] FielkeJ.,Bayhan,Y.&Saglam, C. (2009). Investigation of seedplacement, soilprofileandwheatgermanationfor a combineddual tine andpresswheelseedingmodule (Oral). ISTRO 18 thTriennial Conference, June 15-19,2009 İzmir-Turkey.