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Review/Derleme

EFFECTS OF PLANT NUTRITION ON CANOLA (*Brassica napus* L.) GROWTH

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Abstract: Canola (*Brassica napus* L.*)* is an important edible oilseed crop in the World and in Turkey. It has a healthy vegetable oil because of its balance with omega 3-6-9 essential fatty acids, making canola oil a healthy vegetable oil throughout the World for cooking and processed food industry. Canola production of high yield and good quality usually depends on well-balanced plant nutrition and growing conditions. A well-balanced soil condition also affects canola plants responses to stress factors such as disease and bad weather conditions. Nitrogen, phosphorus and potassium (NPK) are some of the major nutrients required to significantly increase canola yield. Fertilizer application dosages in canola production vary because of the variable occurrence of NPK in the soil. A high yielding canola production needs a well-balanced fertilization program.

Key words: Canola (*Brassica napus* L.), nutrient, fertilization.

Bitki Beslenmesinin Kanola (*Brassica napus* L.) Gelişimi Üzerine Etkisi

Özet: Kanola (*Brassica napus* L.), Dünyada ve Türkiye'de önemli bir yemeklik yağ bitkisidir. Omega 3-6-9 esas yağ asitleri dengesi nedeniyle sağlıklı bir bitkisel yağa sahiptir ve bu özelliği kanola yağını tüm dünyada mutfakta ve işlenmiş gıda endüstrisinde kullanılan sağlıklı bir yağ yapmaktadır. Yüksek verimli ve iyi kalitede bir kanola üretimi için dengeli bitki besin maddeleri kullanımı ve yetiştirme koşulları gereklidir. İyi dengelenmiş bitki besin maddelerince gübrelemesi yapılmış toprak koşulları kanola bitkisini hastalık ve kötü hava koşulları gibi stres faktörlerine karşı daha toleranslı yapmaktadır. Azot, fosfor ve potasyum (NPK) kanola verimini önemli düzeyde arttırmak için gerekli temel besin maddelerinden bazılarıdır. Kanola üretiminde uygulanan gübre dozları, NPK'un topraktaki değişken düzeyleri nedeniyle değişiklik göstermektedir. Yüksek verimli bir kanola üretimi için iyi dengelenmiş bir gübreleme programına ihtiyaç duyulmaktadır.

Anahtar Kelimeler: Kanola, (*Brassica napus* L.), bitki besin maddesi, gübreleme.

Introduction

Canola (*Brassica napus* L.) is the important edible vegetable oilseed crop in Turkey and the World. World canola (rapeseed) planted area accounts for 36,374,397 ha, its production 72,532,995 tons a year, and the yield is about 1994 kg/ha. The size of canola planting areas has been increasing steadily in last ten years in Trakya region of Turkey as a rotation alternative with cereals and other crops. Canola recently reached a planting area of 31,127 ha, a production 102,000 tons/year and a yield of 3276 kg/ha (Anon. 2013a).

Canola is edible oilseed rapeseed name. It is an important crop in Europe since the 13th century for cooking. Canola name was registered in Canada. Canola means "double-low" varieties. Double low canola varieties indicate that the processed oil contains appropriate rate of erucic acid. It has very healthy vegetable oil because of its balance with omega 3-6-9 essential fatty acids. This is making it healthy cooking vegetable oil and for using processed food industry in the World.

However, canola production is not enough for domestic consumption in Turkey, and almost 50% of the oil needs of the country is imported mostly as soybean seed, and crude oil. Therefore, Turkey needs to increase canola oil seeds crops production by using intensive modern plant growing techniques (Süzer 2010a, 2012).

Canola yield and quality mostly rely on the genetic power of the growing varieties and the environmental conditions. Local Turkish and foreign open pollinated and hybrid canola varieties with high productive potential are the varieties mostly grown in Turkey, for which modern agronomic cultivation methods are used. Canola is grown in every soil type with normal fertility level and application of well-balanced N-P-K-S and B fertilizers ensures good soil fertility conditions. However, the main grow limiting factor is the climate. For instance, the most problematic environmental condition is the severe cold temperature values of -15 ^{o}C.

Many studies on fertilizer showed that canola oil seed crops respond to fertilizers. In particular nitrogen, phosphorus and potassium (NPK) are few of the major nutrients required to significantly increase canola yields. Fertilizer application dosages in canola production vary because of the variable occurrence of NPK in the soil. Therefore, in canola production well-balanced fertilization recommendations can help to good quality crop properties.

The usual practice in canola production is to either apply all of the fertilizer in row placement at planting or to use a combination of row and broadcast placement (Forster 1977).

This paper is based on the results found in the literature. The effects of plant nutrition on canola growth presented here are very important to obtain good quality crop properties.

Nutrient Management Strategies of Canola Growth

Canola has secured a place among field crops in crop rotation. It has a profitable crop on crop rotation. It is grown all types of soils from sandy loam to silty clay. In field growing conditions, soil will need additional macronutrients such as Nitrogen, Phosphorus, Potassium, Calcium and Sulphur. Harvesting of canola crop 2.5 to 3.0 t/ha canola will remove about 80 to 100 kg/ha of ammonium phosphate. Therefore to balance the soil N budget removal 80 to 100 kg of nitrogen will be needed. Developing a successful fertilization program in canola growing it can be assumed the soil can get some of macro and micro crop nutrients. In the canola growing season the soil needs extra plant nutrients. Fertilizer management practices for growing canola crop can be described as the application of the correct source of nutrient at economical level, optimal application time and suitable place. For a profitable canola production, the connection of fertilizers' management and integrated agronomic practices are rather important (Süzer 2010a, Anon. 2013b).

Nutrient Requirements of Canola and Fertilization

In field growing conditions, nutrient uptake by canola depends mostly on variety, yield, nutrient and water supply. In high yielding fertile areas where winter canola varieties are grown, a high amount of yield can be obtained. For getting high canola yield from per hectare besides all other growth factors a sufficient supply of water and nutrients from the soil or from fertilizers are needed. For winter type canola growth, 50 to 100 kg/ha fertilizer containing nitrogen with potassium and about 20 to 40 kg/ha calcium with phosphorus should be applied before or during planting. In severe winters conditions, a substantial proportion of the canola leaves are killed by frost and is lost from the plant. (Liu *et al*, 1997, Kacar & Katkat 1999, Orlovius 2003).

Nitrogen Management of Canola Production

Nitrogen (N) management in canola growing is a key factor of achieving high yield and oil level. In crop rotation, canola growth following wheat in a region like Trakya Region of Turkey, the soil needs a balanced N fertilization. Canola is not suitable crop to grow in monoculture cropping systems. Generally in monoculture canola cropping systems N deficiency symptoms in old leaves of plants can be seen. Balanced nutrient budget in soil for canola production is a very important for N fertilization program. Therefore, the total N rate can be assessed based on the yield potential of canola variety and estimated soil nutrient supply during canola growing season in soil. Soil analyses and fertilizer experiments in particular can help assess the balanced and right level of N. Nitrogen requirement of canola plant can be estimated from the expected potential yield. For example, the requirements of canola plant is around 120 kg N/ha. In order to guarantee the high seed yield in canola growth amount of N need should be supplied during growing season. Using high levels of N fertilization can increase seed protein rate and cause to reduce the oil content. However oil content of canola crop may decrease for getting high seed yield from per ha. Using large amount of N fertilizer during canola growing season can decrease the oil content of the harvested crop. Unbalanced nitrogen fertilization in canola growing season may change harvested seed fatty acid profile and glucosinolate contents. But recently developed new modern canola cultivars are less affected by crop nutrition and N fertilization (Süzer 2007, 2010b).

Phosphorus Management of Canola Growth

In canola growth, phosphorus (P_2O_5) is a basic plant nutrient. The application rate of P_2O_5 fertilizer in canola growth changing from 20 to 50 kg P_2O_5/ha depends on the annual total rainfall and the yield expectation from per ha. The use of P_2O_5 forms in canola growth as basal applications of 20-20-0 compose fertilizer is frequent among Turkish farmers in Trakya Region. Basal fertilizers' forms can be applied during canola planting. In some canola fields during plant growth P_2O_5 deficiency delays root development, maturity and crop harvest. In canola growth, less P_2O_5 nutrition availability in soil will also limit the ability of the crop to respond to the other nutrients. During canola growth under severe P_2O_5 deficiency conditions the old leaves will become purple start from edge areas. Some research results show that P_2O_5 fertilization on commercial dosages does not have any effect on canola oil content (Forster 1977, Süzer 2007, 2010b).

Potassium Management of Canola Growth

In canola growth, potassium (K_2O) remains free to regulate many essential processes of plant. Optimal dosage of K_2O nutrient application during growth may help increased disease resistance of canola plants. Canola plants in the field need large amount of K_2O. General symptoms in conola related to K_2O deficiencies are brown and burnt tips of the older leaves. Potassium deficient plants grow slow, have poor root systems and tend to lodging. K_2O related deficiencies are mostly seen on sandy leached soil types (Perrenoud 1990, Süzer 2010b).

Sulphur Management of Canola Growth

In canola growth, sulphur management is very important in order to get high yield from per ha. Sulphur related deficiencies may be seen in canola production fields where large amounts of 15-15-15 compose fertilizers containing less than 2% sulphur are used. Sulphur nutrient can be found in the soil usually organic materials in the form of sulfate (SO_4). Therefore,

Table 1. Symptoms of Nutrient Deficiencies on Canola Plants

Deficient elements	Symptoms of nutrient deficiencies
Nitrogen (N)	Canola lower leaves lighter than upper ones and weak stalks.
Phosphorus (P)	Dark-green foliage of canola; lower leaves sometimes yellow between veins; purplish color on leaves or petioles.
Potassium (K)	Canola lower leaves became mottled and dead areas near tips and margins of leaves.
Calcium (Ca)	Canola's plant tip of the shoot and young leaves dies or became hooked-shaped.
Sulphur (S)	Tip of the shoot and upper young leaves of canola became light green.
Magnesium (Mg)	Canola lower leaves become yellow between veins and leaf margins may curl up and die in later stages.
Boron (B)	Tip of the shoot petioles and new upper young leaves of canola turn brittle.
Manganese (Mn)	Tip of the shoot and new upper young leaves of canola have dead spots over surface.
Iron (Fe)	Tip of the shoot and upper young leaves of canola turn yellow between veins and may die in later stages.

deficiencies related to sulphur can occur when soil pH and calcium content is high, organic matter amount is low. For a profitable canola production it is important to apply enough sulphur in sulphate form during vegetative growing period. Deficiency symptoms in canola plants mostly occur during stem elongation. Sulphur is an elemental form of nutrient and it cannot be carried from older to young leaves. Therefore sulphur deficiency symptoms first appear in the young top leaves as light yellow and gradually reddened colors. To threat sulphur deficiency in canola, spray liquid form of fertilizers can be sprayed to the leaves, as in the case of the application in Trakya Region, during vegetative stages in early spring. The common practice in Trakya region, it can be applied sulphur nutrient with topdressing of ammonium sulfate (21%N, 24%S) forms in canola fields during rosette stages of plants where both N and S deficiencies are can be corrected. According to the results of some studies, topdressing with ammonium sulphate is the best application to treat sulphur deficiency during vegetative period of canola (Süzer 2007, 2010b).

Micronutrient Management of Canola Growth

In canola growth, adequate level of supplying macro and micro nutrients are important to obtain high yields. Sometimes, additional micronutrients can be applied as foliar sprays during canola growth if reliably diagnosed by plant tissue analyses or agronomists. Therefore micronutrient management is important for balanced fertilization in canola growth. Macro and micro nutrients can be applied in field on recommended rates according to the soil and plant analyses results for canola production. Management of plant nutrition is important to prevent acidic reactions in reducing nutrient availability in the soil. If the soil pH is high using chelated micronutrients such as zinc and iron is more efficient (Süzer 2010b, Anon. 2013).

Boron Management of Canola Growth

Boron nutrient management like sulphur is very important for canola production. Boron deficiency symptoms in canola can be seen on young plant leaves become cupped with pale mottled and redden color. Among field crops, canola needs much boron. Boron deficient plants can occur during periods of moisture stress in the canola field. Boron deficiency on canola plants mostly becomes a problem in acidic soils like the ones in Black Sea Region of Turkey. Compared to the other field crops canola needs high boron levels especially when grown on acidic soil types. For successful canola growth, application of right dosages of boron supplements is particularly important because of narrow range between deficiency and toxicity rates (Sachdeva & Khera, 1980, Süzer 2007).

Manganese Management of Canola Growth

Manganese deficiencies are on whole canola plant becomes pale during vegetation period. But this yellow color mostly appears between the veins of younger leaves. In Trakya Region of Turkey, manganese deficiency can be seen on high pH calcareous soil types. In canola growth, it can be seen differences in manganese efficiency among canola cultivars in farmer conditions. Management of manganese fertilization is so important to get high yield from per hectare. Therefore mostly in Trakya Region farmers apply manganese nutrient as a liquate form for spraying onto vegetative stage of canola plants in spring. Normal foliar rates could be between 0.5 and 0.7 kg manganese/ha. The granule form of manganese can be applied during canola planting in furrows between 18 and 20 kg/ha (Sharma *et al*. 1984, Süzer 2010b).

Zinc Management of Canola Growth

In canola growth, zinc nutrient management is very important especially in high pH (alkaline) soil conditions. Mostly, zinc nutrient deficient canola plants during growing period are yellow and have shortened internodes when the plants elongate during spring, as in the conditions of Trakya Region. Some herbicides used in canola production can aggravate zinc deficiency in soil for growing period of plants. Management of zinc can be

treated by using zinc fertilizer or spraying zinc onto leaves of young plants. In such a spraying application on leaves, chelated products of zinc fertilizers can be more efficient than sulfate formulations. For canola production in Trakya Region, zinc nutrients can be applied between 1.0 and 2.0 kg/ha with planting (Süzer, 2010b, Anon. 2013).

Symptoms of Nutrient Deficiencies on Canola Plants

Canola plants will usually shows deficiencies if required nutrients are not present in the soil. These deficiency symptoms were listed in Table 1 (Bergman 1992, Orlovius 2003, Süzer 2007, 2010b).

Integrated Canola Nutrient Management Plan

In canola growth, creating an integrated canola nutrient management plan to obtain higher yields is very important. Soil tests can be done the potential restrictions such as acidity, alkalinity and salinity. Before canola seeding in low pH fields, enough amount of lime or gypsum should be applied to the soil to treat those restrictions. Mostly, field soil type, soil and plant tissue analyses tests help to make correct decisions to apply basal macro and foliar micro nutrient fertilizers.

Conclusion

Nutrient balances are important for evaluating the sustainability of canola growing and for improving nutrient management. Based on soil analyses and field fertilizer research results nitrogen, phosphorous, potassium, calcium, sulphur, boron, manganese, magnesium and iron fertilization helps to increase yield and oil quality of canola crop. Potassium and sulphur application play equally important role as nitrogen and phosphorus in canola plants for their growth and development. Integrated nutrient management on canola production helps to increase yield and income of farmers. According to soil test results, application of fertilizers to production field could results in maximum net returns and is therefore, recommended for profitable canola production.

References

1. Anon. 2013a. FAOSTAT. http://faostat.fao.org
2. Anon. 2013b. http://www.ipni.net. Canola Technology Update: Nutrient Management V1. Mar 2013.
3. Bergmann, W. 1992. *Nutritional Disorders of Plants, Development, Visual and Analytical Diagnosis*. Gustav Fischer Verlag, Jena, 741pp.
4. Forster, H. 1977. Influence of N and K fertilizers on the quality and yield of oil from old and new varieties of rapeseed. *In*: Fertilizer use and production of carbohydrates and lipids. Proc. of the 13th Colloquium of IPI in York/UK.
5. Kacar, B. & Katkat, A.V. 1999. *Gübreler ve Gübreleme Tekniği*. Uludağ Üniversitesi Güçlendirme Vakfı Yayın No:144, Vipaş Yayın No: 20, Bursa.
6. Liu, Y.J., Laird, D.A.& Barak, P. 1997. Release and fixation of ammonium and potassium under longterm fertility management. *Soil Science Societies American Journal* 61: 310-314.
7. Orlovius, K. 2003. Oilseed rape. In: Kirbky, E. A. (Ed.). Fertilizing for High Yield and Quality, IPI Bulletin, Basel, 16, 125pp.
8. Sachdeva C.B. & Khera M.S. 1980. Utilization of potassium from non-exchangeable sources in soil under intensive wheat-bajra cropping system. *Fertilizer News*, 25 (6): 6-10.
9. Perrenoud, S. 1990. Potassium and plant health. IPI-Research Topic No. 3, 2nd ed., Int. Potash Inst.
10. Sharma, K.N., Singh, B., Rana, D.S., Kapur, M L. & Sodhi, J.S. 1984. Changes in soil fertility status as influenced by continuous cropping and fertilizer applications. *Journal of Agricultural Science*, 102: 215-218.
11. Süzer, S. 2007. Production and Importance of Canola in Crop Rotation in Turkey, 277-283. 1st National Oil Seed Crops and Biodiesel Symposium. 28-31 May, Samsun, Turkey.
12. Süzer, S. 2010a. Kanola (Kolza) Tarımında İlkbahar Üst Gübrelemesi ve Besin Maddesi Noksanlıkları. *Hasad Bitkisel Üretim Dergisi*, 25 (297): 88-94.
13. Süzer, S. 2010b. Effects of Potassium Fertilization on Sunflower (*Helianthus annuus* L.) and Canola (*Brassica napus* ssp. *oleifera* L.) Growth. Proceedings of the Regional Workshop of the International Potash Institute, 22-25 November, Antalya, Turkey.
14. Süzer, S. 2012. Kanola Yetiştiriciliği. *Tarım Gündem Dergisi.* 2 (10):70-72.