American Journal of Plant Biology
2021; 6(4): 78-83
http://www.sciencepublishinggroup.com/j/ajpb
doi: 10.11648/j.ajpb.20210604.11
ISSN: 2578-8329 (Print); ISSN: 2578-8337 (Online)

Effects of Seeding Rate and Variety on Growth and Yield of Black Cumin (*Nigella sativa L.*) at Burusa, Southwestern Ethiopia

Mahbuba Shesuleiman, Habtamu Mengistu, Abera Jaleta*

Department of Horticulture, Bedele College of Agriculture and Forestry, Mettu University, Mettu, Ethiopia

Email address:
abera.jaleta@gmail.com (A. Jaleta)

*Corresponding author

To cite this article:
Mahbuba Shesuleiman, Habtamu Mengistu, Abera Jaleta. Effects of Seeding Rate and Variety on Growth and Yield of Black Cumin (*Nigella sativa L.*) at Burusa, Southwestern Ethiopia. *American Journal of Plant Biology*. Vol. 6, No. 4, 2021, pp. 78-83.
doi: 10.11648/j.ajpb.20210604.11

Received: September 13, 2021; **Accepted**: October 22, 2021; **Published**: November 12, 2021

Abstract: Field experiment was conducted at Burusa agricultural research Centre of Mettu University to investigate the effects of seeding rate and variety on growth, yield and some quality parameters of black cumin (Nigella sativa L.). Five seeding rate (10, 15, 20, 25 and 30kgha^{-1}) and three varieties namely Eden, Dirshaye and Local check were used. Factorial RCBD with three replications is used. Data were collected on growth parameters, seed yield and yield components. The data were subjected to ANOVA for statistical analysis using SAS version-9.2 computer software. The result of the study revealed that, most of crop phenology and growth parameters were significantly affected at p<0.05%. Accordingly, the highest plant for consecutive 30, 60 and 60DAS (18.54cm, local; 38.12cm, local and 46.77, Eden) was recorded as those varieties sawn at seeding rate of 30kgha^{-1}. The maximum mean number of primary branch measured at maturity time as (5.3) where recorded when Eden was sawn at 10kgha^{-1}. The mean earliest days to flower initiation (72.4 days) was recorded for Eden Variety while prolonged days to flower initiation (83.2) was recorded for local variety. Following similar patter, mean earliest days to maturity (142.8days) for Eden and prolonged days to maturity (146.3days) was recoded for local variety. Yield contributing characters like number of capsules per plant, number of seeds per capsule, 1000 seed weight, seed yield per plant and seed yield per hectare were maximum when cumin seed variety Eden sawn at seed rate of 10kgha^{-1}. These attributes were found to be minimum for all the three tested varieties sown at seed rate of 30kgha^{-1}. Among various levels of seed rate and three varieties tested, 10kgha^{-1} by Variety Eden could result in highest seed yield (685kgha^{-1}), though it is below national standard which ranged from 900-1600kgha^{-1}. Variety Eden resulted in maximum number of capsule (62.1) and greater seed yield per plant (4.27g) when sawn at 10kgha^{-1}. Local variety achieved promising result for 1000seed weight (1.94g) which is 47.3% higher than that produced at 30kgha^{-1} seeding rate (0.46 g) for variety Dirshaye. Again local varieties produced greater amount of essential oil. Based on the results of the experiment, Eden with 10kgha^{-1} could be used for popularization and need to be subjected to scaling up in the study area.

Keywords: Genotype, Seed Rate, Black Cumin, Yield, Growth

1. Introduction

1.1. Back Ground of the Study

Black cumin (*Nigella sativa L.*) annual herbaceous and flowering plant belonging to the botanical family of *Ranunculacea* is native to south and southwest Asia, the Arabian Peninsula [5]. Black cumin is cultivated in many parts of the world (Tierra, 2005). The edible seed resembling onion seed contains various bioactive molecules such as thymoquinone, thymol, tocopherol, transretinol and selenium, fixed and essential oils, proteins, alkaloids, saponin, and water soluble triterpene has got multipurpose use [2, 3, 14, 18].

For instance, mature seeds are consumed for edible as a food additive and medical purposes for more than 2000 years [9].

Ethiopia is a source country for many spices with a long

history. Spices and herbs are used for several different /applications. As the world is increasingly turning into a global village, culinary traditions from other continents tend to be more widely accepted by consumers, thereby increasing the demand for ethnic and exotic ingredients, like many spices and herbs. Black cumin is one of the most important spice crops in Ethiopia. "According to Yimer, Ethiopia is among major Black cumin producing [8]." In Ethiopia, Black cumin is produced in different parts of the country and the most potential area includes South Gonder, Arsi Zone and Bale Zone [6]. Cumin is among major spices exported from Ethiopia registered higher share both in volume and value terms [8, 19].

In any crop production system, seed rate is the key factor determining effecting the yield and yield [12]. Seed rate has important effect on yield and yield components such as the number of branches, number of umbels, number of seeds per capsule, plant and hectare, 1000 seed weight etc. As the higher plant densities affect negatively the yield and yield component, so optimal seed rate is very important for maximum seed yield.

Different researchers conducted several experiment on black cumin seeding rate and reported that, seeding rate is determined by many factors. According to Halawani if cumin is planted in 40 cm inter and 15 intra raw spacing, a seed rate of 20 to 30 kg ha^{-1} is common [19]. According to Najimi *et al*., a seed 10 $kgha^{-1}$ gave the highest seed yield and better vegetative growth [12]. Similarly, Tuncturk and Turkozu tested four seed rates (5, 10, 15 and 20kg ha^{-1}) and reported that 15 kg ha^{-1} produced maximum number of branches which in turn resulted in maximum yield [11]. The finding of Getinet *et al*., confirmed that, Maximum yield (624 kg ha^{-1}) was obtained with a seed rate of 20 kg ha^{-1} followed by 25 kg ha (491 kg ha^{-1}), 15 kg ha^{-1} (482 kg ha^{-1}) and 10 kg ha^{-1} (395 kg ha^{-1}) [6].

Despite the existing potential, in Ethiopia in general and in the study area in particular, compared to other agricultural crops, coverage and volume of production for spice is very minimal. However, there is still large and growing world demand for unprocessed and ground spices as well as spice extracts such as essential oils and oleoresins. Seeding rate is the most important aspect in crop production. It is highly interrelated with plant density and/or plant spacing. In fact, it depends on various factors like soil fertility, farming system, variety etc.

Considering the above fact, the case of black cumin in the study area is constrained by limited information on production packages. Among which, amount of seed to be sawn per unit of area of suitable variety is the one impeding production and productivity of the crop. Therefore, increasing production and productivity, by introducing improved varieties and modern technologies is among proper measure to be taken. However, the success of a new introduction depends on the available scientific wisdom and crop performance data to a large extent. Keeping in view the above facts, a study will be carried out with the following general and specific objectives.

1.2. Objectives of the Study

1.2.1. General Objective

To examine the effects of seeding rate and variety on growth, yield and some quality parameters of Black cumin at Burussa, southwest Ethiopia.

1.2.2. Specific Objectives

1. To investigate the effect seeding rate on growth, yield and some quality parameters of black cumin at Burrusa, southwest Ethiopia.
2. To determine the effect of variety on growth, yield and some quality parameters of black cumin at Burrusa, southwest Ethiopia.
3. To study the interaction effect between seeding rate and variety on growth, yield and some quality parameters of black cumin at Burrusa, southwest Ethiopia.

2. Material and Methods

2.1. Description of the Study Area

Field experiment was conducted during June, 2018 at Burussa Agricultural Research Centre of Mettu University which is located at the southwestern part of Ethiopia in Oromia regional state at mid altitude sub humid zone and 670 km away from Addis Ababa and 18km from Mettu town to west durection, at 7°42' N latitude and 36°50'E longitude with an altitude of ranging 1050- 1210 m above sea level. The area receives an average annual rain fall of 1200-1350 mm. The area has average maximum and minimum temperature of 26.2°C and 11.3°C, respectively and average maximum and minimum relative humidity of 91.40 and 37.92%, respectively.

2.2. Experimental Design

The experiment consisted of a 3x5 factorial combination of treatments arranged in randomized completely block design (RCBD) with three replications. The first factor of the treatment was seeding rate with five levels (10kg ha^{-1} $15ha^{-1}$, $20ha^{-1}$, $25ha^{-1}$ and $30ha^{-1}$) and the second factor was variety with three levels (local variety as check/control, Dirshaye and Eden).

2.3. Experimental Procedures

2.3.1. Procuring Experimental Materials

The Two improved varieties of Seeds of *Nigella sativa (*Dirshaye and Eden*)* were obtained from Kulumsa Agricultural Research centers while check/control seed was collected from local farmers. According to Getinet *et al*, Dirshaye and Eden were developed by the former Essential Oils Research Center and registered by the Ministry of Agriculture and Rural development, Animal and Plant Health Regulatory Directorate in 2009 [6].

The experimental plot was ploughed for three times and prepared to a fine tilth. Subsequently cross-wise harrowing was done with disc to level the field properly and for provision

of drainage. The field was divided into sub plots as per the layout of experiment. Each experimental plot was 2m×2m with inter-plot spacing of 1 m and inter-block spacing of 2 m. Each plot included 6 rows, and plot size was $4m^2$.

The seed was sown at seed rate of 10, 15, 20, 25 and 30 kg ha^{-1}. Sowing was done by hand in 30 cm apart rows. The seed was dibbled at a depth of 1.5 cm in rows of constant spacing as per the treatment. Cultural operations like fertilizer application, weeding, harvesting and etc were done as per recommendation.

2.3.2. Data Collected

The data collected were; Plant height, Number of leaves per plant, Number of branches per plant, Days to flowering, Days to maturity, Number of capsules per plant, Number of seeds per capsule, 1000 seed weight, Seed yield per plant (g), Essential oil content (% v w-1), Protein content (g kg-1) and Fatty acid content.

2.3.3. Data Analysis

All collected data was subjected to ANOVA and the statistical calculations were performed using SAS version 9.2 computer software. Means comparisons between treatments was performed using the least significant difference (LSD) test. Statistical significance is indicated at a probability level of $p<0.05$.

3. Result and Discussions

The interaction effect of Variety and Seeding Rate on phenological characteristics of Nigella

Variance analysis results are given in the following tables 1. According to results; different seed rates and genotypes were significantly affected the plant height and number of branch per plant, while the main effect had significantly observed on number of days to flower initiation and number of days to first harvest. Data were presented in figures 1 and 2.

Variety and seed rate interaction was significant for plant height at 30 DAS, 60DAS and 90DAS (Table 1). At 30DAS, highest Nigella plant height was obtained from 30 kg ha^{-1} as 18.54 cm for local variety. Within similar growth stage, the lowest plant height was 13.80cm from 10 kg ha^{-1}. The average plant height for local variety (16.11 cm) was higher than that observed (15.55cm) Eden and (15.34cm) Dirshaye. Similar trend was observed at 60DAS and 90DAS, such that, still the highest plant height (38.12cm) and (46.77cm) were recorded for local and Eden variety respectively when Nigella was sawn at seeding rate of 30kgha^{-1}. The lowest plant height at 60DAS and 90DAS were recoded as (28.0cm) and (33.78cm) for local and Dirshaye Variety when Nigella seed was sawn at seeding rate of 10kgha^{-1} (Table 1). At the lower seed rates plant height are lower in per unit area than higher seed rates. When the seed rates increases, Nigella would remarkably increase in height. According to Arici *et al*., plant height increased with increasing seed rate [4].

The number of branches per plant recorded was significantly influenced by variety and seeding rate in this study. The mean maximum number of branches per plant (5.3) was recorded with the seeding rate of 10kgha-1 followed by (4.9) with the same seeding rate for variety Eden and Local respectively. The seeding rate of 30kgha-1 recorded significantly lower number of branches per plant accounts (2.4) for Eden variety (Table 1). The decrease in number of branches per plant with increasing seed rate may be due to the competition among the plants for light, nutrient, water and space. Various studies indicated that the increase in plant densities affected significant reduction in the number of branches [11, 15].

Table 1. *Some phenological characteristics of Nigella as influenced by the interaction effects of variety X seeding rate at different DAS.*

phenological characteristics	seeding rate	Varieties			Statistics
		Dirshaye	Eden	Local	
Plant height	30 DAS				1. CV (%) = 2.22 2. LSD (0.05) = 0.94 Means followed by the same letter are not significantly different at P= 0.05 level
	10 kg ha^{-1}	13.80^{e}	13.89^{e}	14.92^{de}	
	15 kg ha^{-1}	14.11^{e}	14.51^{e}	14.08^{e}	
	20 kg ha^{-1}	15.07^{d}	15.68^{d}	15.80^{d}	
	25 kg ha^{-1}	16.62^{cd}	17.04^{cd}	17.20^{cd}	
	30 kg ha^{-1}	17.11^{c}	16.64^{d}	18.54^{bc}	
	60DAS				1. CV (%) = 11.6 2. LSD (0.05) = 1.41 Means followed by the same letter are not significantly different at P= 0.05 level
	10 kg ha^{-1}	30.82^{a}	31.87^{a}	28.00^{a}	
	15 kg ha^{-1}	31.31^{a}	33.90^{a}	29.32^{a}	
	20 kg ha^{-1}	32.92^{b}	34.75^{bc}	30.82^{b}	
	25 kg ha^{-1}	34.28^{bc}	35.32^{c}	32.54^{bc}	
	30 kg ha^{-1}	36.83^{e}	36.81^{cd}	38.12^{e}	
	90DAS				1. CV (%) = 8.95 2. LSD (0.05) = 2.05 Means followed by the same letter are not significantly different at P= 0.05 level
	10 kg ha^{-1}	38.06^{f}	33.78^{f}	35.17^{f}	
	15 kg ha^{-1}	39.84^{f}	37.42^{g}	39.82^{g}	
	20 kg ha^{-1}	40.92^{gh}	41.41^{hi}	43.50^{h}	
	25 kg ha^{-1}	41.89^{g}	44.25^{ij}	42.87^{hi}	
	30 kg ha^{-1}	41.41^{g}	46.77^{ij}	45.90^{hij}	
Number of branches per plant	10 kg ha^{-1}	5.3^{a}	4.5^{ab}	4.9^{a}	1. CV (%) = 10.3 2. LSD (0.05) = 0.98 Means followed by the same letter are not significantly different at P= 0.05 level
	15 kg ha^{-1}	4.1^{b}	4.8^{ab}	4.5^{b}	
	20 kg ha^{-1}	4.4^{a}	2.7^{bc}	3.5^{a}	
	25 kg ha^{-1}	3.7^{ab}	3.5^{a}	3.6^{a}	
	30 kg ha^{-1}	2.8^{b}	2.4^{cd}	2.6^{b}	

Highly significant difference ($p<0.05$) was observed in number of days to Nigella flower initiation. However, number of days to flower initiation was affected by neither interaction nor the seed rate. Thus, the great difference observed in terms of number of days to flower initiation is due to genotype. The mean earliest days to flower initiation (72.4 days) was recorded for Eden Variety while Dirshaye recorded (76.6 days). A prolonged day to flower initiation (83.2 days), that was delayed by about 6.6 and 10.8 days respectively from Dirshaye and Eden was observed in local variety (Figure 1). Kulumsa agricultural research Centre conducted research on those varieties during 2009 cropping season at eight test locations and the result confirmed that, Eden takes 66 to 72 days from planting to flowering while Dershaye requires 69 to 82days to flower. With regard to seed rate, no statistical difference was detected in days to flower initiation. The probable reason for the significant difference observed among Nigella plants different variety in day to flower initiation is due to the genetic response to exiting environment.

Mean data on different varieties of Nigella days to first harvest sawn at different seed rate are shown in (Figure 2). Considering Nigella days to first harvest as affected by varieties followed a similar pattern to that of days to flowering. Here too, results confirmed again the Eden variety is ready for harvest earlier (142.8days) than the rest variety. Maximum days to first harvest (146.3days) that were delayed by about 2.6 days from Dirshaye and 3.5 days from Eden were recorded in local variety. Kanter *et al*. confirmed that, both Dershaye and Eden require 134 to 150 days from planting to full maturity [7]. Concerning number of days to first harvest, the effect of different seed rates was found not to be statistically significant for the high and low seed rates. In this study, the variation observed in Nigella days to first harvest could be explained by the genetic potential of populations.

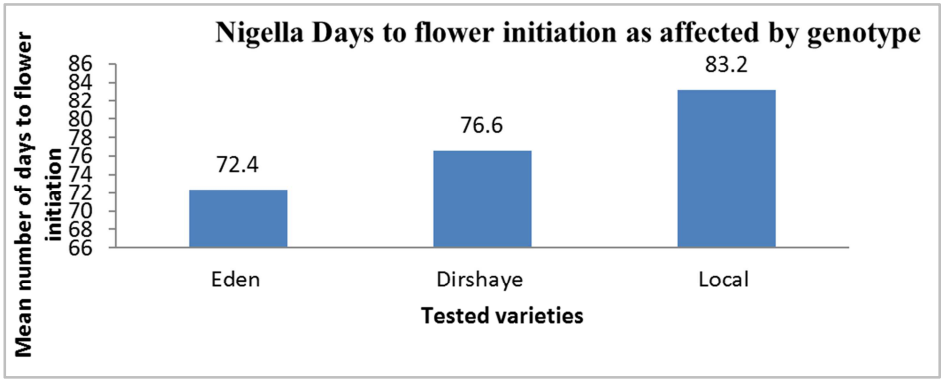

Figure 1. *Nigella mean days to flower initiation as affected by genotype.*

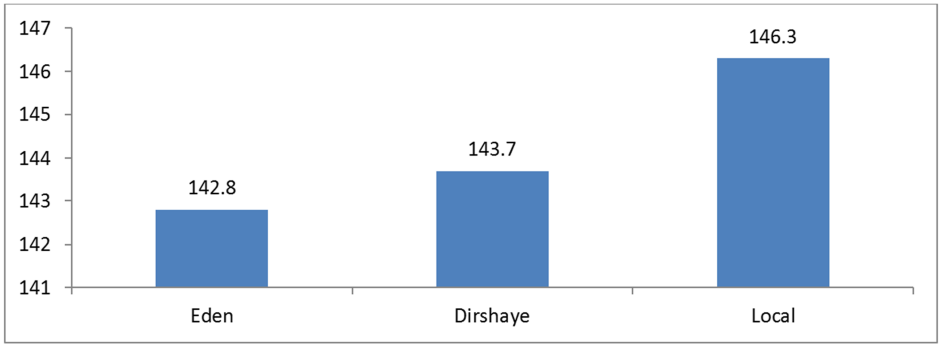

Figure 2. *Nigella mean days to maturity as affected by genotype.*

The interaction effect of Variety and Seeding Rate on some yield and yield components of Nigella

Mean data presented in Table 2 indicates the interaction effect on some yield components of Nigella. Number of capsule is considered as yield components and it is highly affected by seeding rate and variety of Nigella. The interaction effect of seeding rate and variety was highly significant on the number of capsule per plant ($p<0.05$) (Table 2). The highest value (92.1) was observed at seed rate 10kgha^{-1} for Eden variety and the lowest (56.7) was obtained at 30kgha^{-1} seed rate for local variety. Environmental conditions during pollination at the first stage of seed set, determine the number of capsule per plant [10].

With similar pattern, number of seed per pod is also affected by seed rate and variety, such that, the maximum number seed per capsule (32.5) was obtained at 10kgha^{-1} seed rate with insignificant value of 15kgha^{-1} which is 31.92 for Eden variety. Dirshaye variety produced the lowest seed per capsule (28.3) when it was sawn at 30kgha^{-1}. In fact, the number of seeds per pods is the reservoir capacity of the

plant. Plants keep photosynthetic material and ultimately lead to increase in biomass. Number of pods per plant and number of seeds per pods are good indicators of seed yield.

The thousand seed weight is another important yield component which has direct impact on final yield of crop. It was obtained by counting 1000-seeds of each sample using an automated seed counter. The results of analysis of variance indicated that 1000-seed weight was highly affected by the interaction between variety and seeding rate at $p<0.05$. Although not statistically different, when local variety was sawn at10 $kgha^{-1}$ and 15$kgha^{-1}$, it produced the highest 1000-seed weight (2.60 g and 2.94g respectively) which was averagely 47.3% higher than that produced at 30$kgha^{-1}$ seeding rate (1.46 g) for variety Dirshaye (Table 2). Means comparison of the interaction between variety and seeding level showed that the treatment of local variety and application of 10 $kgha^{-1}$ had the highest 1000-seed weight (2.81g) and the treatment of Dirshaye variety with the application of 30 kg $seedha^{-1}$ had the lowest one (1.46g).

The present results have indicated that seed yield was significantly affected by genotype and seeding rate ($p<0.05$). Among various levels of seed rate, 10kgha-1 could result in highest seed yield (1750$kgha^{-1}$) for Eden. Dirshaye and local variety when sawn at the lowest seed rate (10$kgha^{-1}$) achieved almost similar seed yield (1680 and 1612 kgha-1). The lowest seed yield was found when high seed rate 30kgha-1 was used for local and Eden variety. In different studies focusing on seed rate, researchers Abdolrahimi *et al*, Shah and Ali *et al*. found that seed yield $ha^{-1}$for black cumin were in the ranges of 1400-2150kg ha^{-1} [1, 16, 17, 20]. The National Variety Registry Committee (NVRC) reported that the average national yield potential of Nigella is assumed to be 1500$kgha^{-1}$. Besides, it has been reported that, in some places of Ethiopia where is considered as cumin belt, seed yield observed up to 1500-2500$kgha^{-1}$. At higher seeding level, inter-plant competition usually increases and hence decreases seed yield per plant. The present result of seed yield per hectare is found in the mentioned references. A wide range of factors, such as variety, growing conditions, climatic factors and soil properties affect thousand seed weight.

Genotypes were statistically different from each other in seed yield per plant. Maximum seed yield per plant was observed in Eden variety (4.27 g) and minimum in local variety (3.30g). Dirshaye were moderate as 3.55g. Seed rate also effect significantly in seed yield per plant. Maximum yield was obtained 10kgha-1 (4.77 g), followed by 15kgha-1 (4.58 g), which was statistically different. Seed rate of 20kgha-1 (3.10 g) was moderate and 30kgha-1 seed rate (2.19 g) which was statistically different lower (Table 2). In interaction, maximum (5.40 g) yield was obtained when Eden was sawn at 10$kgha^{-1}$ and minimum (1.95 g) yield was obtained when local variety was sawn at 30$kgha^{-1}$.

Table 2. *The interaction effects of variety X seeding rate on number of capsule per plant, number of seed per capsule, 1000 seed weight, seed yield per plant and seed yield per hectare of Nigella sativa.*

Yield and yield component parameters	Seeding rate	Varieties			Statistics
		Dirshaye	Eden	Local	
Number of capsules per plant	10 kg ha^{-1}	88.5^{a}	92.10^{a}	80.24^{a}	1. CV (%) = 6.5 2. LSD (0.05) =4.04 3. Means followed by the same letter are not significantly different at P= 0.05 level.
	15 kg ha^{-1}	83.71^{a}	89.60^{b}	75.55^{ab}	
	20 kg ha^{-1}	75.68^{b}	85.67^{cd}	64.30^{abc}	
	25 kg ha^{-1}	61.44^{c}	68.62^{edc}	60.80^{bc}	
	30 kg ha^{-1}	58.04^{cd}	60.20^{e}	56.74^{ce}	
Number of seed per capsule	10 kg ha^{-1}	31.0^{f}	32.50^{ef}	31.37^{f}	1. CV (%) = 14.8 2. LSD (0.05) = 0.11 3. Means followed by the same letter are not significantly different at P= 0.05 level.
	15 kg ha^{-1}	30.5^{g}	31.92^{fgh}	30.30^{ghi}	
	20 kg ha^{-1}	29.6^{gh}	30.9^{ij}	30.08^{ghi}	
	25 kg ha^{-1}	29.7^{gh}	29.1^{hij}	30.5^{hij}	
	30 kg ha^{-1}	28.3^{fgh}	29.4^{hi}	28.07^{ij}	
1000 seed weight (g)	10 kg ha^{-1}	2.55^{a}	2.46^{a}	2.60^{a}	1. CV (%) = 15.7 2. LSD (0.05) = 4.34 3. Means followed by the same letter are not significantly different at P= 0.05 level.
	15 kg ha^{-1}	2.15^{a}	2.32^{a}	2.94^{a}	
	20 kg ha^{-1}	1.99^{ab}	1.87^{b}	2.83^{a}	
	25 kg ha^{-1}	1.89^{abc}	1.50^{b}	1.68^{b}	
	30 kg ha^{-1}	1.46^{abc}	1.47^{b}	1.49^{b}	
Seed yield per plant (g)	10 kg ha^{-1}	5.33^{a}	5.40^{a}	5.38^{a}	1. CV (%) = 11.9 2. LSD (0.05) = 3.25 3. Means followed by the same letter are not significantly different at P= 0.05 level.
	15 kg ha^{-1}	4.61^{a}	5.12^{a}	4.56^{a}	
	20 kg ha^{-1}	3.99^{a}	4.47^{a}	3.82^{b}	
	25 kg ha^{-1}	2.23^{b}	3.23^{bc}	2.88^{bcd}	
	30 kg ha^{-1}	1.98^{bc}	2.08^{bc}	1.95^{edc}	
Seed yield per hectare (kg)	10 kg ha^{-1}	1680^{a}	1750^{a}	1612^{a}	1. CV (%) = 4.7 2. LSD (0.05) = 0.44 3. Means followed by the same letter are not significantly different at P= 0.05 level.
	15 kg ha^{-1}	1609^{b}	1720^{b}	1604^{b}	
	20 kg ha^{-1}	1596^{c}	1680^{c}	1552^{c}	
	25 kg ha^{-1}	1542^{d}	1621^{d}	1511^{d}	
	30 kg ha^{-1}	1560^{e}	1584^{e}	1440^{e}	

4. Conclusion and Recommendation

This study demonstrated that lower seed rate ($10kgha^{-1}$) with Eden variety consistently increased primary branch, leaves per plant, capsule per plant, seed pieces per pod, 1000seed weight, yield per plant and total yield of black cumin of local land race under rain fed conditions. The above attributes were significantly lower in the crop sown at $30kgha^{-1}$. However, the higher seed rate ($30kgha^{-1}$) resulted in maximum plant height and earliest days to flowering and crop maturity. The present investigation revealed that all the traits studied were significantly influenced by level of seed rate. Seed rate of $10kgha^{-1}$ increased total yield by 10.66% as compared to $30kgha^{-1}$ for Eden Variety. This clearly shows potentially the best possible use of lower seed rate ($10kgha^{-1}$) in areas with similar agro-ecological characteristics of the study area. So production of Eden variety at $10kgha^{-1}$ is recommended for the study area and similar agro-ecology. As the crop is undoubtedly suitable for the study area, there is a need to evaluate the crop in different farming situations. Further, there is also a need to study the performance of the crop in the context of economic viability. Additionally, augmenting present theme of study with any other agronomic measures like nutrition, irrigation, as well as pathological aspects is very important.

References

[1] Abdolrahimi, B., Mehdikhani, P. and Tappe, A. H. G. 2012. The effect of harvest index, yield and yield components of three varieties of black seed (Nigella sativa) in different planting densities. *International Journal of Agri Science*, 2 (1): 93-101.

[2] Ali BH, Blunden G. Pharmacological and toxicological properties of Nigella sativa. Phytother Res 2003; 17 (4): 299-305. 6. Khan MA, Chen HC, Tania M, Zhang DZ. Anticancer activities of *Nigella sativa* (black cumin). *Afr J Tradit Complement Altern Med* 2011; 8 5 Suppl: 226-32. 7.

[3] Al-Jassir M. S., (1992) Chemical composition and microflora of black cumin (Nigella sativa L.) seeds growing in Saudi Arabia. Food Chem; 45: 239-42.

[4] Arici M, Sagdic O, Gecgel U., (2005). Antibacterial effect of Turkish black cumin (Nigella sativa L.) oils. Grasas y Aceites; 56: 259-62.

[5] ARSHAD, H., (2015). Nigella sativa and Its Active Constituents Thymoquinone Shows Pivotal role in the diseases prevention and treatment: Asian J Pharm Clin Res, Vol 8, Issue 1, 48-53.

[6] Getinet Alemaw, Adam Abebe, Daniel Bisrat, Asmamaw Yeshanew, Dereje Regassa and Fekadu G/Tensay, (2010). Registration of Plant Varieties; Ethiop. J. Agric. Sci. 20: 179-194.

[7] Kanter, M., O. Coskun and M. Budancamanak, 2005. Hepatoprotective effects of *Nigella sativa* L and *Urticadioica* L on lipid peroxidation, antioxidant enzyme systems and liver enzymes in carbon tetrachloride-treated rats. World J. Gastroenterol., 11: 6684-6688.

[8] Yimer M., (2010). Market Profile on Spices: Ethiopia, Addis Ababa Ethiopia.

[9] Ozlem, T. and Suleyman k., (2004). Effect of Seed Rate on Agronomic and Technologic Characters of Nigella sativaL. International Journal of Agriculture & Biology. Int. J. Agri. Biol., Vol. 6, No. 3, 2004.

[10] Salgueiro L, Martins AP, Correia H. Raw materials: the importance of quality and safety. A review. *Flavour Fragr J. 2010; 25: 253–271.*

[11] Tuncturk, M., Ekin, Z. and Turkozu, D. 2005. Response of black cumin (Nigella sativa L.) to different seed rates growth, yield components and essential oil content. Journal of Agronomy. 4 (3): 216-219.

[12] Najmi, A., M. Nasiruddin, R. A. Khan and S. F. Haque, 2013. Indigenous herbal product *Nigella sativa* proved effective as an antihypertensive in metabolic syndrome. Asian J. Pharm. Clin. Res., 6: 61-64.

[13] Halawani, E., 2009. Antibacterial activity of thymoquinone and thymohydroquinone of *Nigella sativa* L. and their interaction with some antibiotics. Adv. Biol. Res., 3: 148-152.

[14] Khan, S. B., Faisal, M., Rahman, M. M. and Jamal, A., 2011. Exploration of CeO_2 nanoparticles as a chemi-sensor and photo-catalyst for environmental applications. Science of the total Environment, 409 (15), pp. 2987-2992.

[15] Hammo, Y. H., 2008. Effect of high levels of nitrogen and phospours fertilizer, pinching, and seed rate on growth and yield componentes of Nigella sativa L. 1-Vegetative growth and seed yield. Mesopotamia J. of agric, 36 (1), pp. 1-12.

[16] Ali, M. M. K., Hasan, M. A. and Islam, M. R., 2015. Influence of fertilizer levels on the growth and yield of black cumin (Nigella sativa L.). The Agriculturists, 13 (2), pp. 97-104.

[17] Shah, S. H., 2008. Effects of Nitrogen Fertilisation on Nitrate Reductase Activity, Protein, and Oil Yields of Nigella sativa L. as Affected by Foliar GA_ {3} Application. Turkish Journal of Botany, 32 (2), pp. 165-170.

[18] Sultan, MT., MS. Butt, FM. Anjum, A. Jamil, S. Akhtar and M. Nasir. 2009. Nutritional profile of indigenous cultivar of black cumin seeds and antioxidant potential of its fixed and essential oil. Pakistan J. Botany. 41: 32-40.

[19] Yilmaz, G. 2008. New approaches in growing of medicinal and aromatic plants. Graduate Course Notes (unpublished). Gaziosmanpasa University Agriculture Faculty, Field Crops, Tokat. (in Turkish)

[20] Ozel, A., U. Demirel, I. Guler and K. Erden. 2009. Effect of different row spacing and seeding rate on black cumin (Nigella sativa L.) yields and some agricultural characters. Harran Uni. J. of Agriculture Faculty. 13 (1): 17-25. (in Turkish).