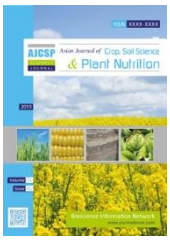
Published with Open Access at Journal BiNET
Vol. 09, Issue 02: 363-368
Asian Journal of Crop, Soil Science and Plant Nutrition
Journal Home: https://www.journalbinet.com/ajcsp-journal.html



Optimization of seed rate of black cumin mixed with onion in Charland of AEZ-3

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Article received: 12.04.2023; Revised: 15.01.2024; First published online: 15 February 2024.

ABSTRACT

An experiment was conducted in farmer's field at Charlands of Char Gonai, Kaunia, Rangpur, during Rabi season of 2021-22 to determine the seed rate of onion mixed with black cumin under Charland conditions. The trial was conducted with five treatments viz., Recommended Seed Rate (RSR) of onion+10% RSR of black cumin, RSR of onion+20% RSR of black cumin, RSR of onion+30% RSR of black cumin and Sole Onion set in a randomized complete block design (RCBD) with three replications. The highest bulb yield was recorded in sole onion (18.0 tha^{-1}) and the lowest was harvested in RSR of onion+30% RSR of black cumin (7.0 tha-1). All the parameters showed variations due to the varied seed rate of companion crop black cumin except plant height (cm) and active pods plant^{-1}. The highest grain yield was recorded in sole black cumin (548.15 kg ha^{-1}) and the lowest was harvested in RSR of onion+20% RSR of black cumin (337.04 kgha^{-1}). The maximum land equivalent ratio (1.39) was estimated in RSR of onion+10% RSR of black cumin and minimum (0.81) was calculated in RSR of onion+30% RSR of black cumin. The highest gross return Tk.360000 ha^{-1} and gross margin Tk.179900 ha^{-1} with highest benefit-cost ratio of 3.21 was calculated in Sole onion and the lowest gross return Tk. 192400 ha^{-1} and gross margin Tk.12300 ha^{-1} with lowest benefit-cost ratio of 1.07 was obtained in RSR of onion+30% RSR of black cumin. Sole BARI Piaz-4 may be a good option for higher yield and economic return in Charland situations. Seed rate of black cumin mixed with BARI Piaz-4 should be around 10% in Charland while, direct seeded onion seed rate should be less than the recommended dose for successful and viable economic return.

Key Words: *Optimization, seed rate, onion mixed and Charland*

Cite Article: Haque, M. E., Farid, M. N., Rahman, M. M., Fahim, A. H. F., Anwari, A., Sarkar, M. N., Mohammad, A. and Ahmed, M. M. (2024). Optimization of seed rate of black cumin mixed with onion in Charland of AEZ-3. Asian Journal of Crop, Soil Science and Plant Nutrition, 09(02), 363-368. **Crossref:** https://doi.org/10.18801/ajcsp.090224.44

I. Introduction

Bangladesh is already feeling the adverse effects of climate change and global warming. Increasing per unit yield by utilizing finite land resources is the fundamental problem of the new millennium. In Bangladesh, the area covered by Charland is considered 0.83 million hectares. Mixed cropping is the process of growing two or more crops close together. The majority of intercropping has taken place in underdeveloped nations. The farmers in Bangladesh's char regions regularly engage in this activity. Intercropping has been taken into consideration to improve crop production's sustainability (Coolman and Hoyt, 1993). The intercropping system should be considered one of the key strategies to boost productivity.

Additionally, it has become a crucial instrument for raising crop productivity (Santalla et al., 2003). Better intercrop output can be achieved by selecting the right crop mixture, population density, and planting geometry (Myaka, 1995) of the constituent species/crops. One method of intercropping is using onion and black cumin. Black cumin, also known as Nigella sativa, is an annual herbaceous plant cultivated in arid and semiarid regions. It holds immense medicinal value and is widely used in traditional medicine for treating various ailments (El-Mahrouk et al., 2022). Farmers in Bangladesh's char areas are accustomed to and use intercropping techniques frequently.

Approximately 3.38 percent of the nation's total arable land is used for growing spices. Maximum plant density is also advantageous for healthy plant development, successful capsule production, and other qualities. When plants are sufficiently dense, they fully utilize the environmental factors of water, air, light and soil, which result in the predicted branching, number of effective capsules, and seed quality (Sadeghiu et al., 2009). Crops in Charland experience water stress at various growth phases, distinct from the situation on plain ground. By lowering evapotranspiration, plant population could reduce water stress. A scant amount of research has been done on the seed rates of the crops that make up the mixed cropping system used in Char to grow onions and black cumin. In light of the abovementioned viewpoints, a study has been conducted to determine the optimal production and financial return seeding rate.

II. Materials and Methods

The experiment was conducted in farmer's field at charlands of Char Gonai, Kaunia, Rangpur, during Rabi season of 2021-22 to determine the seed rate of onion mixed with black cumin under Charland conditions. The trial was conducted with five treatments viz., i) Recommended Seed Rate (RSR) of onion+10% RSR of black cumin, RSR of onion+20% RSR of black cumin, RSR of onion+30% RSR of black cumin and Sole Onion set in a randomized complete block design (RCBD) with three replications. Land was ploughed, cultivated and then prepared for seed sowing through different methods. Plots were fertilized with cowdung @ 3 tha^{-1} and N58, P43, K46 S20 $kgha^{-1}$. The entire quantity of cowdung, P, K, S and ½ N was applied during final land preparation and the rest of N was applied in two equal splits at 20-40 days after sowing. Seeds of black cumin were soaked and treated with provax @2.5g kg-1 seeds before sowing. Seeds were broadcast on November 27, 2021, according to the treatment requirements (Figure 01).

Figure 01a. Field view of the experimental plot

Figure 01b. Layout preparation after seed sowing

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Intercultural operations were done as and when necessary. Autostin @ 2gL^{-1} and Amistertop @ 2gL^{-1} were applied at 25, 65 and 75 days after sowing. Crops were harvested on April 18, 2022. Data on number of capsules plant^{-1}, Number of filled capsules plant^{-1}, Number of seeds capsule^{-1}, Seed yield g plant^{-1} and Yield (kg ha^{-1}) were recorded. The data were statistically analyzed using Statistix-10 software and the mean differences were tested using the least significant difference (Gomez and Gomez, 1984). Onion Equivalent Yield (OEY) and Land Equivalent Ratio (LER) were calculated using the formula by Willey (1979), which has been generally accepted as an agronomically sound index for assessing yield advantages derived from an intercropping practice.

OEY=Yio+Yibc*Pbc/Po
Where,
Yio= Yield of intercropped onion,
Yibc= Yield of intercropped black cumin,
Pbc= Market price of black cumin,
Po= Market price of onion

LER= OIY /OSY + BCIY /BCSY
Where,
OIY = Yield of intercropped onion,
OSY= Yield of sole onion,
BCIY= Yield of intercropped black cumin,
BCSY= Yield of sole black cumin

III. Results and Discussion

Effect of main crop (Onion)

Yield and yield contributing characters of onion have been furnished in Table 01. All the parameters showed non-significant variations due to the varied seed rate of companion crops except plot yield and yield (tha^{-1}). Plant population^{-2} ranged from 63.0 to 71.33. The lowest (63.0) number of plants^{-2} were recorded in sole onion plot compared to all the plots of mixed black cumin intercropping system. This might be due to the very closed and intertwisted onion seedlings with onion or black cumin seedlings, which could not be removed during thinning or weeding to avoid injury of surrounding seedlings. Plant height (cm) showed non-significant variations among the tested treatments. Bulb diameter (mm) showed significant variations among the varied seed rate treatments under trial, ranging from 31.57 cm to 46.85 cm. Statistically, the highest bulb yield was recorded in sole onion (18.0 tha^{-1}) and the lowest was harvested in RSR of onion+30% RSR of black cumin (7.0 tha^{-1}), which is statistically identical to that of RSR of onion+20% RSR of black cumin (7.09 tha^{-1}) in Charland situation.

Table 01. Yield and yield contributing parameters of onion mixed with varying black cumin seed rates at Charland of Tapamodhupur, Kaunia, Rangpur during 2021-22

Treatments	Plants m^{-2}	Plant height (cm)	Bulb diameter (mm)	Plot yield (kg)	Yield (tha^{-1})
RSR of onion+10% RSR of black cumin	70.33a	55.67a	39.65b	10.47b	11.63b
RSR of onion+20% RSR of black cumin	70.33a	56.67a	35.05c	6.383c	7.09c
RSR of onion+30% RSR of black cumin	71.33a	54.67a	31.57c	6.30c	7.0c
Sole Onion	63.0a	55.33a	46.85a	16.20a	18.0a
Lsd	-	-	4.1453	1.6515	1.835
Level of significance	NS	NS	**	**	**
CV (%)	14.84	4.84	11.23	8.4	8.4

*Recommended seed rate=RSR

Effect of companion crop (black cumin)

All the parameters showed significant variations due to the varied seed rate of companion crop black cumin except plant height (cm) and active pods plant^{-1} (Table 02). Plants m^{-2} ranged from 25.33 to 80.67. Non-significant variations were observed in plant height, ranging from 59.0 cm to 67.0 cm. Statistically, the highest grain yield was recorded in sole black cumin (548.15kg ha^{-1}) and the lowest was harvested in RSR of onion+20% RSR of black cumin (337.04 kgha^{-1}). Alam et al. (2024) stated that non-cereal mixed croppings, such as chili, brinjal, radish and coriander, has been shown to increase yield by 191 to 254% and profitability by 126-225% more than sole chili cultivation. In addition, mixed cropping allows farmers to grow multiple crops on the same plot of land, maximizing land use efficiency.

EISSN 2706-5510

Table 02. Effects of varying black cumin seed rate on yield and yield contributing parameters in onion-black cumin mixed cropping system at Charland of Tapamodhupur, Kaunia, Rangpur during 2021-22

Treatments	Plants m^{-2}	Plant height (cm)	Total pods $plant^{-1}$	Active pods $plant^{-1}$	Inactive pods $plant^{-1}$	Plot yield (g)	Yield ($kgha^{-1}$)
RSR of onion+10% RSR of black cumin	25.33c	59.67a	7.50b	5.33a	2.0b	366.67b	407.41b
RSR of onion+20% RSR of black cumin	38.67b c	59.0a	7.67b	5.0a	2.67ab	303.33c	337.04c
RSR of onion+30% RSR of black cumin	46.67b	61.67a	8.50ab	4.6667a	3.50a	210.0d	233.33d
Sole black cumin	80.67a	67.0a	9.17a	5.83a	3.0ab	493.33a	548.15a
Lsd	20.301	-	1.4225	-	1.2896	60.946	67.718
Level of significance	**	NS	*	NS	*	**	**
CV (%)	21.24	11.81	8.67	17.45	23.12	8.88	8.88

*Recommended seed rate=RSR

Land equivalent ratio (LER)

The Land Equivalent Ratio (LER) has been generally accepted as an agronomically sound index for assessing yield advantages derived from an intercropping practice (Willey, 1979). However, LER does not consider that, in subsistence agriculture, it is usually important to maintain a certain minimum percentage of the pure stand yield of the staple crop component in an intercropping system. The highest land equivalent ratio (1.39) was estimated in RSR of onion+10% RSR of black cumin and the lowest (0.81) was calculated in RSR of onion+30% RSR of black cumin which indicated that RSR of onion+10% RSR of black cumin is suitable intercropping system and RSR of onion+30% RSR of black cumin is not acceptable regarding Land equivalent ratio (LER) among the treatments under trial (Table 03). According to Muoneke et al. (2007), inter/mixed cropping increases the system yield of component crops overall while reducing the probability of crop failure due to weather conditions. The study utilized the Land Equivalent Ratio (LER) to evaluate yield advantages, and it revealed that the RSR of onion+10% RSR of black cumin was the most effective intercropping system.

Table 03. Land equivalent ratio (LER) of onion-black cumin mixed cropping system at Charland of Tapamodhupur, Kaunia, Rangpur during 2021-22

Treatments	Yield of onion (tha^{-1})	Yield of black cumin ($kgha^{-1}$)	Land equivalent ratio (LER)
RSR of onion+10% RSR of black cumin	11.63	407.41	1.39
RSR of onion+20% RSR of black cumin	7.09	337.04	1.01
RSR of onion+30% RSR of black cumin	7.0	233.33	0.81
Sole Onion	18.0	-	1
Sole black cumin	-	548.15	1

*Recommended seed rate=RSR

Onion equivalent yield

Highest onion equivalent yield was harvested in sole onion (18.0 tha^{-1}), whereas the lowest was found in RSR of onion+30% RSR of black cumin (9.62 tha^{-1}), which was very close to that of RSR of onion+20% RSR of black cumin (10.88 tha^{-1}). Again, RSR of onion+10% RSR of black cumin gave 16.21 tha^{-1} onion equivalent yields (Table 04). Lalotra et al. (2022) stated that mixed cropping yields more because it is more resilient to disease and insect damage, maximizes soil nutrient usage, reduces weed pressure and can hold more water due to its larger area coverage. The study further revealed that the sole onion plot had the highest gross return and gross margin with the highest benefit-cost ratio of 3.21, while the RSR of onion+30% RSR of black cumin plot had the lowest gross return and gross margin with the lowest benefit-cost ratio of 1.07.

Cost and return

Cost and return of onion mixed with black cumin in char land have been shown in Table 04. The highest gross return Tk. 360000 ha^{-1} and gross margin Tk.179900 ha^{-1} with highest benefit-cost ratio of 3.21was calculated in Sole onion and the lowest gross return Tk.192400 ha^{-1} and gross margin

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Tk.12300 ha^{-1} with lowest benefit-cost ratio of 1.07 was obtained in RSR of onion+30% RSR of black cumin.

Table 04. Cost and return of varying black cumin seed rates in onion-black cumin mixed cropping system at Charland of Tapamodhupur, Kaunia, Rangpur during 2021-22

Treatments	Onion Equivalent yield (tha^{-1})	Gross return ($Tk.ha^{-1}$)	Total cost of production ($Tk.ha^{-1}$)	Gross margin ($Tk.ha^{-1}$)	Benefit -cost ratio
RSR of onion+10% RSR of black cumin	16.21	324200	180100	144100	1.80
RSR of onion+20% RSR of black cumin	10.88	217600	180100	37500	1.21
RSR of onion+30% RSR of black cumin	9.62	192400	180100	12300	1.07
Sole onion	18.0	360000	180100	179900	2.00
Sole black cumin	6.17	123400	38500	84900	3.21

*Recommended seed rate=RSR, Farmgate price of onion= Tk.20 kg^{-1}, Black cumin = Tk.225 kg^{-1}

IV. Conclusion

BARI Piaz-4 is undoubtedly the best variety for maximizing yields and economic returns in Charland situations. To achieve optimal results, it's recommended that a seed rate of black cumin mixed with BARI Piaz-4 should be around 10% in Charland. It's important to note that a higher seed rate may adversely affect bulb onion yield. For successful and viable economic returns, direct seeding of onion should be less than the recommended dose. Introducing BARI Piaz-4 in char areas can significantly increase onion production.

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HOW TO CITE THIS ARTICLE?

MLA

Haque, M. E. et al. "Optimization of seed rate of black cumin mixed with onion in Charland of AEZ-3". Asian Journal of Crop, Soil Science and Plant Nutrition, 09(02), (2024): 363-368.

APA

Haque, M. E., Farid, M. N., Rahman, M. M., Fahim, A. H. F., Anwari, A., Sarkar, M. N., Mohammad, A. and Ahmed, M. M. (2024). Optimization of seed rate of black cumin mixed with onion in Charland of AEZ-3. *Asian Journal of Crop, Soil Science and Plant Nutrition*, 09(02), 363-368.

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Haque, M. E., Farid, M. N., Rahman, M. M., Fahim, A. H. F., Anwari, A., Sarkar, M. N., Mohammad, A. and Ahmed, M. M., F. "Effect of different types of mulch on watermelon yield and profitability in the saline soil of coastal Bangladesh". Asian Journal of Crop, Soil Science and Plant Nutrition, 09(02), (2024): 363-368.

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Haque, M. E., Farid, M. N., Rahman, M. M., Fahim, A. H. F., Anwari, A., Sarkar, M. N., Mohammad, A. and Ahmed, M. M.. 2024. Optimization of seed rate of black cumin mixed with onion in Charland of AEZ-3. Asian Journal of Crop, Soil Science and Plant Nutrition, 09(02), pp. 363-368.

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Haque ME, Farid MN, Rahman MM, Fahim AHF, Anwari A, Sarkar MN, Mohammad A and Ahmed MM. Optimization of seed rate of black cumin mixed with onion in Charland of AEZ-3. Asian Journal of Crop, Soil Science and Plant Nutrition, February 2024 09(02), 363-368.