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A Study the Physiological Factor of the Eruca Sativa L Plant

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ABSTRACT:

The current study considers physiological characteristics like rate of transpiration. The goal of the research is to achieve heterosis through hybridization. The following parameters were evaluated during the current investigation. Although the physical properties of these three Indian rocket variants are known to some extent and briefly discussed in this paper, they have not been extensively explored. Rate of transpiration was measured in three varieties of Rocket with the help of Ganong's potometer. Materials used in the measurement of rate of transpiration was beaker, Ganong's potometer, a plant twig of Rocket and safranin solution. To measure the rate of transpiration the plant chamber is filled with water and the twig of rocket was inserted to the chamber by means of a rubber cork. The distance covered by the air bubble in the horizontal tube , which is caused due to exertion of suction created by transpiration, was observed minutely.

Keywords: Rocket Plant (Eruca), Physiological Parameter, Rate of Transpiration, Utilization of Plant Etc.

1. Introduction

The term sativa in plant binomial is a Latin adjective derivedfrom satum, supine of verb sero, which means to sow, indicating that plant's seeds are spread in a garden. Rocket may grow on dry, disturbed earth. This plant's roots are sensitive to nematodes. Rocket is a spicy, leafy green vegetable that resembles long-leafed open lettuce. It is currently commercially grown in many regions and may be purchased at supermarkets and farmers' markets. Gargeer is the Indian name for ripe rocket seeds.
Sativa, one of the plant's synonyms, derives latin satum, which means "to sow," implying that the plant's seeds were spread in gardens. Eruca sativa varies from E. vesicaria in that its sepals are early deciduous. Some botanical researchers considered it a subspecies of E. vesicaria, namely E. v. subsp. sativa. Others do not distinguish between the two.(ebge.org.uk)
The English common term rocket comes from French roquette, which is a derivation from Italian ruchetta, a diminutive of ruca, from the Latin word eruca.
The term "arugula" (/əˈruːɡələ/), which is now widely used in the United States and Canada, originated in a nonstandard dialect of Italian. The normal Italian term is "rucola". According to the Oxford English Dictionary, "arugula" first appeared in American English in a 1960 New York Times article by Craig Claiborne, a culinary editor and prolific cookbook writer.
Raw arugula is 92% water, 4% carbs, 2.5% protein, and has very little fat. A 100 g (3+1⁄2 oz) reference portion contains just 105 kJ (25 kcal) of dietary energy. It is high in folate and vitamin K, accounting for 20% or more of the Daily Value (DV). Arugula contains 10-19% of the daily value of vitamin A, vitamin C, and the minerals magnesium, calcium, zinc, and selenium.

Energy -	105 KJ(25 kcal)
Protein -	2.6 gm
Carbohydrates -	3.6 gm
Fat -	0.6gm
Sugars -	2.0gm
Dietary Fiber -	1.6gm

Table 1: Vitamins

Vitamins	Quantity	%DV[†]
Vitamin A equiv. beta-Carotene lutein zeaxanthin	119 µg 1424 µg 3555 µg	13% 13%
Vitamin A	2373 IU	
Thiamine (B1)	0.044 mg	4%
Riboflavin (B2)	0.086 mg	7%
Niacin (B3)	0.305 mg	2%
Vitamin B6	0.073 mg	4%
Folate (B9)	97 µg	24%
Vitamin C	15 mg	17%
Vitamin E	0.43 mg	3%
Vitamin K	108.6 µg	4%

Table 2: Minerals

Minerals	Quantity	%DV
Calcium	160 mg	12%
Copper	0.076 mg	8%

Iron	1.46 mg	8%
Magnesium	47 mg	11%
Manganese	0.321 mg	14%
Phosphorus	52 mg	4%
Potassium	369 mg	12%
Sodium	27 mg	1%
Zinc	0.47 mg	4%
Water	91.7 g	

Utilization

Fresh rocket leaves give a peppery crisp flavor to a variety of foods and are commonly used as salad veggies across the world. Rocket plant has grown in popularity in recent years as consumers seek a handy, healthy, and easily available product. Fresh rocket leaves are very alkaline and antioxidant-rich. Certain phytochemicals are also found, with protective and disease-preventing qualities.

It inhibits carcinogenic effects of estrogen & protects against prostate, breast, cervical, colon, & ovarian cancer. This plant can also prevent the development of cancer cells and have cytotoxic effects on them. This plant has high levels of vitamin A and flavonoid chemicals. These flavonoid molecules found in rocket can help prevent humans from skin, lung, and mouth cancer. These flavonoid molecules are regarded a significant characteristic of the plant since they operate as an anti-allergic, anti-cancer, antioxidant, anti-inflammatory, and antiviral material.

Rocket also has a high concentration of folates, or folic acid. Consuming this plant's leaves during the conception phase may help avoid neural tube abnormalities in newborn kids.The plant contains vital minerals such as calcium, magnesium, potassium, sulfur, iron, phosphorus, and selenium. The plant is renowned asa medicinal herb & is used as anaphrodisiac, to treat eyeinfections, digestion, & renal issues.

2. Review of Literature

Helana Michale et al. (2011) investigated the biological activity as an anticancer drug in vitro, as well as the chemical contents of fresh leaves. In phytochemical studies, an aqueous extract of Eruca sativa fresh leaves was shown to contain nine natural flavonoid components.

WT Kasem et al. (2011) investigated the seed coat & seed morphological sculpturing of 32Brassicaceae species. LM and SEM were used to evaluate 32 Brassicaceae species and their seed exomorphic characteristics.

Mohamed H AL - Whaibi et al. (2012) investigated the growth performance and photosynthetic pigment status of rockets, as well as effect of plantgrowth regulators. To increase rocket plant performance, the viability of using plant growth regulators(kinetin GA3, spermidine, & napthaline acetic acid)was investigated.

Kenneth J Berba and Mark E Uchanski (2012) investigated microgreens and their postharvest physiology.

Gupta et al. (2013) investigated rocket plants' defensive response to the fungal disease Alternaria brassiciola, including the development of β-1,3-glucanase & chitinaseactivities. Plants have evolved several methods to combat the majority of possible microbial infections and illnesses, according to their findings.

AK Indoria et al. (2013) investigated the phytoextractability of Cd in soil as modified by sewage sludge and farmyard manure in several oilseed species.

Ushahra Jyoti and CP Malik (2014) conducted research on the antioxidant defense system in degraded rocket seed and the function of oxidative stress.

Haroon Khan and Murad Ali Khan (2014) investigated Eruca sativa's urease inhibitory and antiulcer properties. This studyaims to investigate and understand influence of urease activity in vitro.
E. Mangwende et al. (2015) conducted research on Albugo candida, the organisms responsible for rocket white rust. Typical white rust signs were found in two commercial garden rocket crops grown in South Africa throughout the winter.
Muhammad Aqeel Kamran et al. (2015) investigated effectof rhizobacteria inoculation oncadmium (Cd) absorption by rocket plants, which has a growth-promoting effect. The current investigation was meant to screen for varied cadmium levels & their ability to deal withCd absorption fromsoils, rocket plant nested possessions, and Pseudomonas putida (ATCC 39213).
Idress Al Gehani et al. (2016) investigated the development and physiological processes of rockets cultivated in salinity conditions, as well as the effect of soil amendments.
B. Nejadhasan et al. (2017) investigated the germination of rocket seeds under various environmental conditions. He carried out this experiment to see how environmental parameters like as water potential, salinity, temperature, and planting depth affect germination.
Sandeep Kumar et al. (2017) investigated rapeseed mustard resistance to the mustard aphid, Lipaphis erysimi, as well as its physical and biochemical properties.
Sawsan Kadhim Mashi and Dina Saadoon Dheyab (2018) investigated the impact of rocket leaf extract onosteoporosis produced by phosphoricacid and pathological alterations in bone in adult malerabbits.
Yong-Joon Choi et al. (2018) investigated the downy mildew pathogen of arugula, Hyaloperonospora erucae sp. nov.
Ajay Kumar et al. (2019) focused on improving the quality of flax growth and output in Uttarakhand, Tarai area, India, using integrated nutrient management.
Mona Adel El-Wakeel et al. (2019) investigated the bioherbicidal activity of rocket. Their research demonstrates how to explore the allelopathic potential of rocket aqueous extract of fresh shoot as a natural bioherbicide for controlling Beta vulgaris and Phalaris minor weeds, as well as its influence on Pisum sativum yield and growth features.
Franklin EM Santiago et al. (2020) investigated differential selenium tolerance in arugula and lettuce on a biochemical basis.
Khushboo Khator et al. (2020) investigated association b/w two genotypes & antioxidant in terms of physiologically and morphological changes.
M Vahabi Mashhoor et al. (2021) investigated the elm leaf bettle Xanthogalerucaluteola and the antifeedant activity of an arugula oil nanoemulsion formulation.
Ebisa Olika Keyata et al.(2021) investigated the phytochemical content, antioxidant activity, & functional qualities of Raphanussativus L., Eruca sativaL., and Hibiscus sabdariffa L. plants grown inEthiopia.
Arthur Ferrari Teixeira et al. (2022) investigated the chemicalanalysis of Eruca sativa ethanolic extract & its effects onhyperuricaemia. They found a hypouricaemic response in hyperuricaemic Wister rats treated with ethanoloic extract at a level of 125 mg/kg.
Sheharyar Khan et al. (2022) investigated the influence of osmotic stress on seedgermination, temperature, & seedling development in Eruca sativaMill. They concluded that germination models are useful for observing dormancy periods, crop management, and forecasting emergence timeframes.
HS Gadow et al. (2022) conducted experimental and theoretical investigations on rocket seed extract. This study included electrochemical, chemical, electrical frequency modulation, potentiodynamic polarization, and electrochemical impedance spectroscopy methods.

Mustafa Cuce and Asiye Sezgin Muslu (2022) studied role ofexogenous SNP in alleviating effects of PQ-mediatedoxidative stresson rocket plantlets cultivated in MS basalmedium.
Maria Cristina Sorrentino et al. (2023) state that ionizingradiation (IR) & its effect onorganisms are increasingly being explored owing to its potentialapplications in grown plants. We investigated effects of ionizing radiation onEruca sativa by examiningplants developed from irradiatedseeds (1 and 10 Gy) under hydroponics. We assessed a variety of morphophysiological parameters as well as genotoxicity. Radiation exposure resulted in significant variation in morphophysiological parameters, indicating lower plant vigor. Shoot length and leaf count were substantially greater in 1 Gy-treated samples, whereas root length was significantly higher in 10 Gy-treated plants. The number of stomata increased considerably with IR exposure, however pigment and Rubisco concentrations decreased due to radiation stress.
Sona S. El-Nwehy et al. (2023) found that applying all three components foliarly (CMS + Zn + B) resulted in the highest seed production (184.6 g/m2) and oil content (675.3 kg/ha). In compared to the control group, the macronutrient content of N, P, K, Mg, and Ca increased by 34.4%, 56%, 42%, 45%, and 39% in seeds treated with these components, respectively. Furthermore, carbohydrates, proteins, phenolics, flavonoids, and antioxidants all rose by 24%, 34%, 21%, 43%, and 28%, respectively, as compared to the control group. Gas-liquid chromatography analysis found ten components in the seed oil, with more unsaturated fatty acids ranging from 81.28% to 92.28% and lower saturated fatty acids ranging from 6.72% to 8.21%. As a consequence, foliar spraying with CMS, zinc, and boron can help minimize salt impacts on Rocket plants cultivated under saline water irrigation circumstances while enhancing growth, yield, extraction of oils, and nutritional content such as total carbs, proteins, and nutritional levels.
Ayşe ÖZKAN et al. (2024) investigated how chitosan treatment affects rocket production and quality. The "Bengi" rocket type was used as a plant stuff, and chitosan was sprayed into the foliage at four different doses (0 (control), 75, 150, and 300 ppm). The yield values were between 1691 and 1914 g m-2, plant height above 24.33 and 27.92 cm, and leaf width between 4.56 and 5.71 cm across all applications. Total dry matter, chlorophyll, total phenolics, vitamin C, and antiradical activity levels ranged from 7.71% to 8.68%, 34.15 and 36.68 SPAD, 104.67 and 180.84 mg 100 g-1, 126.63 and 143.51 mg 100 g-1, and 63.77% and 71.87%, correspondingly.

Objectives of the Study

1. The research paper aims to collect information on various Eruca Sativa l. plant kinds in India from New Delhi.
2. Analyze plant physiological factors of Eruca Sativa l. plant

Material Used

Local Variety Gargeer (LVG)

Spherical dark brown seeds, plants from 20 to 100 cm long, strongly sharply lobed leaves with four to ten little peripheral lobes and a large terminal lobe, corymb-shaped flowers 2-4 cm in diameter, petals creamy white or golden purple veined, and stamens yellow.The plant is massively branched. The fruit, a siliqua, is 12-25 mm long and bears an apical beak containing several seeds.

Greater Noida Taramira (GNT)

Plants range in length from 30 to 120 cm, with deeply pinnately lobed leaves that have six to fourteen little lateral lobes and one huge terminal lobe. Flowers are 2-4 cm in diameter and form a corymb. Petals are creamy white or golden-purple veins, while stamens are yellow. The fruit, a siliqua about 12-25 mm long, contains an apical beak containing many seeds.

Ludhiana Composite Taramira (LCT)
The plant has spherical dark brown seeds, is 20 to 110 cm long, and has deeplypinnately lobed leaves withfour to fourteen little lateral lobes & a broad terminal lobe. The flowersare 2-4 cm in diameter and grouped in corymb. The petals are creamywhite or yellow withpurple lines, & stamens are yellow.The fruit ranges from 12 to 25 mm in length and has an apical beak carrying several seeds.

3. Methodology- Physiological Studies

Rate of Transpiration
A rocket plant twig is taken. Ganong's Potometer is used for the experiment. After filling the plant chamber with water, a plant twig is put into the chamber using a rubber stopper. The free bent end of the horizontal tube is put below the water level in a beaker whose water has been colored reddish by adding a few drops of safranin. An extra amount of water is taken in the reservoir at the start of the experiment. One air bubble is put into the horizontal tube. The water in the horizontal tube is regulated as desired using the stop cork, which is located just below the water reservoir. Vaseline is used to make the equipment airtight. Here, the distance covered by the air bubble in the horizontal tube owing to suction pressure is monitored minutely.

4. Observation and Result Discussion

Rate of transpiration was measured in three varieties of Rocket with the help of Ganong's potometer. Materials used in the measurement of rate of transpiration was beaker, Ganong's potometer, a plant twig of Rocket and safranin solution .Transpiration creates suction on the water surface present in a plant chamber,What amount of water that was evaporated during this process through the ariel parts of the plant twig, can be measured with the help of graduated horizontal tube on the potometer. To measure the rate of transpiration the plant chamber is filled with water and the twig of rocket was inserted to the chamber by means of a rubber cork.The free bend end of the horizontal tube is placed below the water level contained in a beaker whose water is made reddish by adding a few drops of safranin. One air bubble is introduced in the horizontal tube.The regulation of water in the horizontal tube , as desired is made with the help of stop cork, present just below the water reservoir. The application of Vaseline or wax was helpful in the making of the apparatus air tight.
The distance covered by the air bubble in the horizontal tube , which is caused due to exertion of suction created by transpiration, was observed minutely. The recorded observation is shown in table 3 and fig.1.

Table 3: Rate of Transpiration

MATERIALS	YEAR	TIME TAKEN CONSTANT (30min)	BASED ON 10OBSERVATION					RATE OF TRANSPIRATION
			Distance moved	MEAN	± S.E.	RANGE	C.V. (%)	
GNT	2022	12:30 to 1:00pm	10	9.8	± .26	9-11	14.02	.33
GNT	2023	1:00 to 1:30pm	12	12.1	± .34	10-13	8.13	.40
LCT	2022	12:40 to 1:10pm	10	9.8	±	9-11	12.01	.33

					..12			
LCT	2023	1:10 to 1:40pm	14	11.6	± .35	11-13	10.01	.46
LVG	2022	1:00 to 1:30pm	13	77.1	± .26	10-12	17.11	.43
LVG	2023	12:30 to 1:00pm	10	12.1	± .35	11-13	18.01	.33
Mean difference of all the varieties is significant from each other at 1% level.								

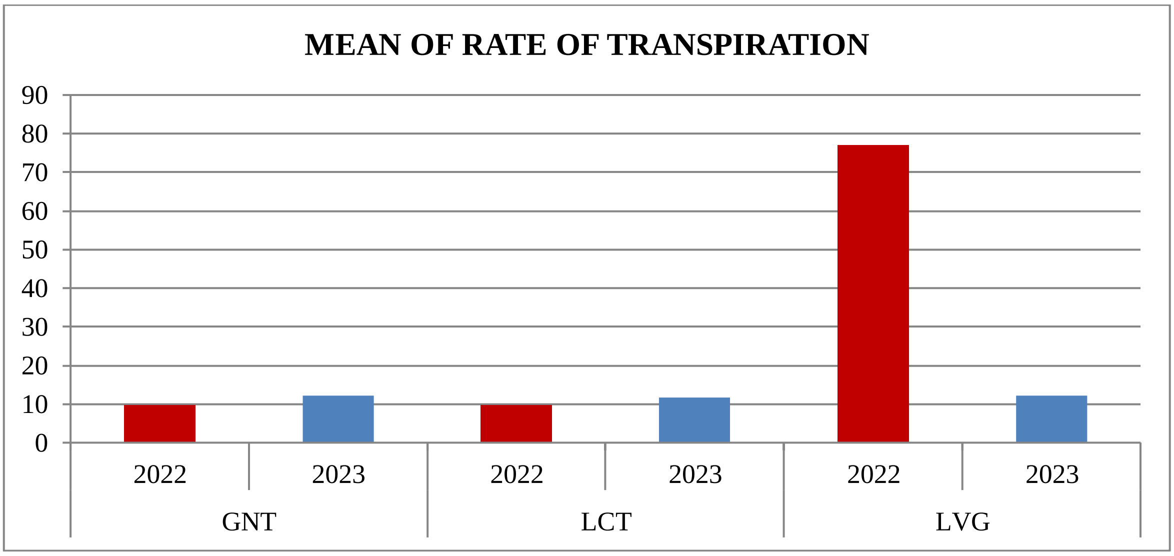

Fig.1: Mean of Rate of Transpiration

Comparative Physiological Study of Different Varieties of Rocket and Their F1 Hybrids
Rate of Transpiration

Transpiration is release of surplus waterfrom plants in form ofwater vapour. To analyze this characteristic in the Rocket plant's F1 hybrids, a minute observation is made by tracking the movement of the water bubble over a set time period. It was shown that LCT X GNT had the greatest rate of transpiration, followed by LVG X GNT. The lowest rate of transpiration was recorded by LCT X LVG

Table 4: Rate of Transpiration in Parental Forms of Rocket and Their F1 Hybrids

MATERIALS	**TIME TAKEN CONSTANT (30min)**	**BASED ON 10OBSERVATION**				**RATE OF TRANSPIRATION**
		Distance moved	MEAN	± S.E.	C.V. (%)	
LCT	12:30 to 1:00pm	14	11.7	± .36	9.34	.36
LCT X LVG	1:00 to 1:30pm	12	12.3	± .36	9.31	.40
LCT X GNT	12:40 to 1:10pm	15	13.1	± 5.57	.23	.05
GNT	1:10 to 1:40pm	12	12.0	± .33	8.75	.46
GNT X LCT	1:00 to 1:30pm	13	11.0	± .25	7.36	.43
GNT X LVG	12:30 to 1:00pm	12	11.7	± .29	8.03	.40
LVG	1:00 to 1:30pm	10	12.0	± .36	9.58	.36
LVG X LCT	12:30 to 1:00pm	10	11.9	± .39	11.05	.33
LVG X GNT	12:00 to 12:30pm	11	11.7	± .36	10.26	.36

*Based on ten observations.

The mean difference between all the hybrids is significant to each other at the 1% or 5% level, and to their parent at the 1% level.

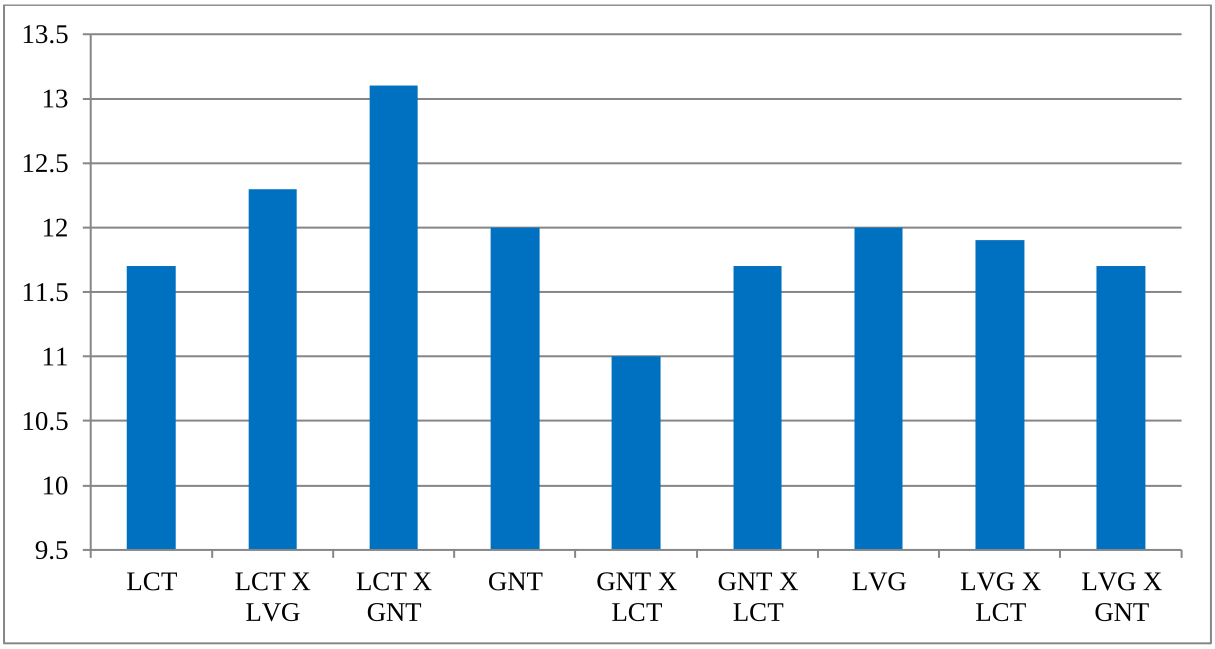

Fig. 2: Rate of Transpiration in Parental Forms of Rocket and Their F1 Hybrids

5. Conclusions

Rocket is a major vegetable crop, but it has received little attention from cytologists, geneticists, and plant breeders. Many earlier works on crop Brassies have been published by various authority, each addressing a distinct issue. Despite the fact that the genetic structure of Rocket varietal populations is extremely important in plant breeding, we currently have very little knowledge on it. The current study consider physiological characteristics. The goal of the research is to achieve heterosis through hybridization. The rocket varietal populations studied here differ genotypically in a variety of physiological characteristics. F1 intervarietal hybrids outperform their parents in physiological characteristics, which can be regarded an example of heterosis due to enhanced heterozygosity. Result shows that the transpiration is release of surplus waterfrom plants in form of water vapour. To analyze this characteristic in the Rocket plant's F1 hybrids, a minute observation is made by tracking the movement of the water bubble over a set time period. It was shown that LCT X GNT had the greatest rate of transpiration, followed by LVG X GNT. The lowest rate of transpiration was recorded by LCT X LVG.

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