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EFFICACY OF PLANT GROWTH REGULATORS ON NITROGEN FRACTIONS OF MEDICINALLY IMPORTANT OIL YIELDING PLANT SIMAROUBA GLAUCA DC. UNDER WATER STRESS CONDITIONS

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Abstract:

Nitrogen is an important macro-element, building block of proteins and much important for better plant growth. Water stress is one of the major abiotic stresses, changes the physical environment and affects plant growth and development. One year old seedlings of *Simarouba glauca* DC. were subjected to water stress for 4,8,12 and 16 days. Control plants were regularly watered. The foliar sprays of 50 ppm SA and 10 ppm Putriscine, GABA and Abscisic acid (ABA) were applied between each stress. The attempt has been made to investigate effect of PGRs on nitrogen nutrion and related enzyme of medicinal important oil yielding plant *Simarouba glauca* DC. under water stress conditions. It was noticed that total nitrogen and nitrate reductase activity were decreased and nitrate content was increased under water stress conditions. Exogenous application of these PGRs showed increase in total nitrogen, nitrate, nitrate reductase activity. These results indicate that SA, Putriscine, GABA and Abscisic acid plays a vital role in drought tolerance.

Keywords: SA, Putriscine, GABA and Abscisic acid, total nitrogen, nitrate, nitrate reductase.

Introduction:

S. glauca is commonly known as 'Laxmitaru' or 'paradise tree' belonging to family Simaroubaceae. It is medicinally important oil yielding plant (1). According to (2), nitrogen is an important macro-element, play a vital role in many biochemical reactions that are responsible for plant life. Water stress, changes the environment for plant growth and development (3). To induced tolerance to water stress various plant growth regulators such as salicylic acid (4), polyamines (5) and abscisic acid (6) were applied. In the light of these observations it was thought worthwhile to study effect of water stress on nitrogen fractions in medicinally important oil yielding plant *Simarouba glauca DC.*

Material and Methods:

One year old seedlings of *Simarouba glauca* DC. were transplanted in earthen pots. Seedlings were settled by watering regularly in polyhouse of Botany Department of Shivaji University. After one month plants were subjected to water stress for 4,8,12 and 16 days. Control plants were regularly watered. The foliar sprays of 50 ppm SA and 10 ppm Putriscine, GABA and Abscisic acid (ABA) were applied between each stress. Total nitrogen content was determined following the method given by (7). Nitrate content was analyzed according to method described (8). Method described by (9) was applied for determination of nitrate reductase.

Results and discussion:

From the **Table1 and Figure 1** it is observed that total nitrogen content is decreased in root, stem and leaves of stressed control plants as compared to control plants. Elevation in total nitrogen content due to foliar application of ABA, SA, Putrescine and GABA is noticed in all stressed plants as compared to control stressed plants. It is more pronounced due ABA, SA, and GABA. In plants nitrogen is highly important macro element. It is fundamental constituent of proteins, nucleic acids, nitrate, nitrite, amino acids, amides, urea, ammonia and quaternary ammonium compounds. (10) Reported reduced amount of nitrogen due to water shortage throughout the growth period in bean. Foliar application of SA increases nitrogen at pH 6.5 in (11). According to (12), total nitrogen in pearl millet was increased due to exogenous application of SA. Significant increase in total nitrogen content due to foliar application of putrescine in chickpea (*Cicer arientinum*) was observed by (13).

As shown in **Table 2 and Figure 2**, it is observed that due to effect of foliar sprays of ABA, SA, Putrescine and GABA nitrate content in the root, stem and leaves of *S. glauca* subjected to water stress treatment is increased progressively with increasing water stress. The leaf tissue shows higher nitrate content than stem and root tissue. Nitrate is primary form of nitrogen taken up from the soil. Nitrate is major source of inorganic nitrogen for the plants (14). (15) Reported that mass of the plant species subjected to water stress showed a marked increase in nitrate concentration. (16) Observed that GABA promotes NO3 - at low NO3 – concentration followed by increase in tissue level of NO3. They concluded that GABA produced during stress is capable of regulating NO3 - uptake and metabolism during stress.

From the **Table 3 and Figure 3** it is observed that the nitrate reductase activity is decreased progressively with increasing water stress in leaf tissue of water stressed unsprayed plants. Further increase in nitrate reductase activity due to foliar application of PGRs, ABA, SA, putrescine and GABA is also noticed in the leaves of *S.glauca* grown under water stressed conditions. In this respect the application of SA and GABA influences the NR activity more prominently as compared to others PGRs. According to (17), NR in higher plants has much economic importance as it controls both carbon and nitrogen metabolism. (18) Noticed ABA increased nitrate reductase activity, photosynthetic rate and decreased transpiration rate under water stress condition (19) reported that SA protects the NR activity in wheat plants under water deficit conditions.

Table: 1.Effect of foliar sprays of ABA, SA, Putrescine and GABA on nitrogen content of the root, stem and leaves of *S. glauca* grown under water stress.

Plant parts	Treatments	Stressed Control	Abscisic acid	Salicylic acid	Putreceine	GABA
Leaves	Unstressed Control	0.856	0.856	0.856	0.856	0.856
	4 (Days)	0.463 (-45.91)	0.669 (-21.84)	0.654 (-23.59)	0.546 (-36.21)	0.669 (-21.84)
	8 (Days)	0.446 (-47.89)	0.694 (-18.92)	0.517 (-39.60)	0.46 (-46.26)	0.579 (-32.35)
	12 (Days)	0.359 (-58.06)	0.575 (-32.88)	0.435 (-49.18)	0.427 (-50.11)	0.517 (-39.60)
	16 (Days)	0.334 (-60.98)	0.536 (-37.38)	0.37 (-56.775)	0.359 (-58.06)	0.456 (-46.72)
Stem	Unstressed Control	0.323	0.323	0.323	0.323	0.323
	4 (Days)	0.258 (-20.12)	0.356 (+10.21)	0.284 (-12.07)	0.28 (-13.31)	0.291 (-9.90)
	8 (Days)	0.248 (-23.21)	0.313 (-3.09)	0.348 (+7.73)	0.208 (-35.60)	0.346 (+7.12)
	12 (Days)	0.176 (-45.510)	0.266 (-17.64)	0.28 (-13.31)	0.208 (-35.60)	0.298 (-7.73)
	16 (Days)	0.138 (-57.27)	0.251 (-22.29)	0.154 (-52.32)	0.196 (-39.318)	0.302 (-6.50)
Root	Unstressed Control	0.327	0.327	0.327	0.327	0.327
	4 (Days)	0.244 (-25.38)	0.302 (-7.64)	0.266 (-18.65)	0.251 (-23.24)	0.32 (-2.140)
	8 (Days)	0.194 (-40.67)	0.323 (-1.22)	0.32 (-2.14)	0.297 (-9.17)	0.304 (-7.03)
	12 (Days)	0.111 (-66.05)	0.226 (-30.88)	0.176 (-46.17)	0.143 (-56.26)	0.151 (-53.82)
	16 (Days)	0.104 (-68.19)	0.14 (-57.18)	0.14 (-57.18)	0.125 (-61.77)	0.151 (-53.82)

Each value is mean of three determinations.

Values are expressed as **g100^{-1}g dry wt.**

Values in parenthesis indicate percent increase (+) or decrease (-) over the control

Table: 2. Effect of foliar sprays of ABA, SA, Putrescine and GABA on nitrate content of the root, stem and leaves of *S. glauca* grown under water stress.

Plant parts	Treatments	Stressed Control	Abscisic acid	Salicylic acid	Putrescine	GABA
Leaves	Unstressed Control	347.28	347.28	347.28	347.28	347.28
	4 (Days)	384.49 (+10.714)	341.08 (-1.785)	483.72 (+39.28)	524.03 (+50.89)	539.53 (+55.35)
	8 (Days)	396.89 (+14.28)	378.29 (+8.92)	443.41 (+27.68)	396.89 (+14.28)	412.4 (+18.75)
	12 (Days)	443.41 (+27.68)	303.87 (-12.5)	477.51 (+37.5)	477.51 (+37.5)	520.93 (+50.00)
	16 (Days)	462.01 (+33.03)	505.42 (+45.53)	468.21 (+34.82)	365.89 (+5.35)	334.88 (-3.57)
Stem	Unstressed Control	43.41	43.41	43.41	43.41	43.41
	4 (Days)	58.91 (+35.70)	86.82 (+100)	99.22 (+128.56)	74.41 (+71.4)	89.92 (+107.14)

	8 (Days)	52.71 (+21.42)	46.51 (+7.141)	74.41 (+71.41)	62.01 (+42.84)	77.51 (+78.55)
	12 (Days)	62.01 (+42.84)	55.81 (+28.56)	80.62 (+85.71)	62.01 (+42.84)	74.41 (+71.41)
	16 (Days)	80.62 (+85.71)	55.81 (+28.56)	86.82 (+100)	55.81 (+28.56)	86.82 (+100)
Root	Unstressed Control	40.31	40.31	40.31	40.31	40.31
	4 (Days)	86.82 (+115.38)	65.11 (+61.52)	105.73 (+162.29)	96.12 (+138.45)	120.93 (+200)
	8 (Days)	62.01 (+53.83)	71.31 (+76.90)	106.74 (+164.79)	49.61 (+23.07)	89.92 (+123.071)
	12 (Days)	71.31 (+76.90)	102.32 (+153.83)	83.72 (+107.69)	99.22 (+146.14)	108.52 (+169.21)
	16 (Days)	93.02 (+130.76)	74.41 (+84.59)	117.82 (+192.28)	89.92 (+123.07)	108.52 (+169.21)

Each value is mean of three determinations.

Values are expressed as **$mg100^{-1}g$ dry wt.**

Values in parenthesis indicate percent increase (+) or decrease (-) over the control

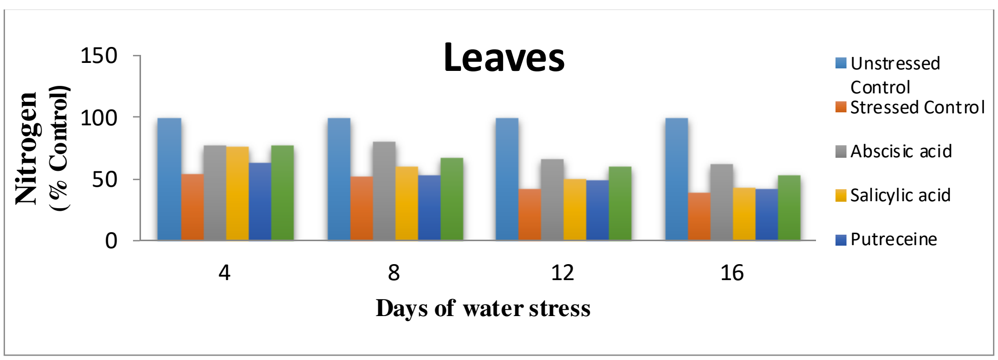
Table: 3. Effect of foliar sprays of ABA, SA, Putrescine and GABA on the activity of enzyme nitrate reductase in the leaves of *S. glauca* under water stress.

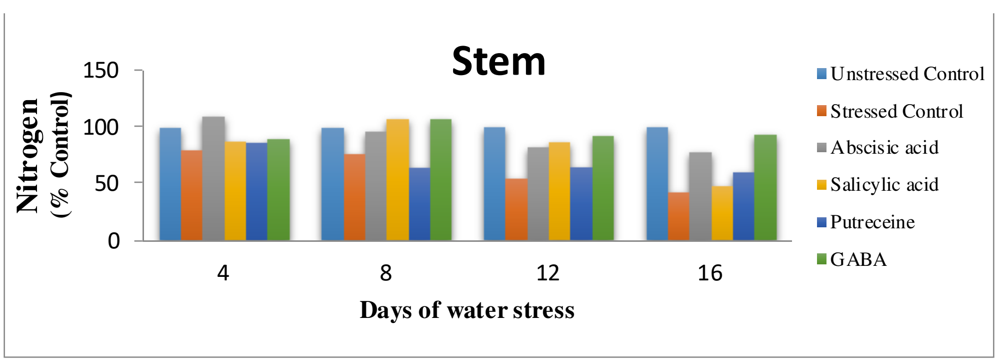
Treatments	Stressed Control	Abscisic acid	Salicylic acid	Putrescine	GABA
Unstressed Control	0.12	0.12	0.12	0.12	0.12
4 (Days)	0.0844 (-29.66)	0.078 (-5.33)	0.11 (-8.33)	0.1 (-16.66)	0.114 (-5)
8 (Days)	0.062 (-48.33)	0.085 (+19.166)	0.092 (-23.33)	0.063 (-47.5)	0.098 (-18.33)
12 (Days)	0.043 (-64.16)	0.048 (+4.166)	0.081 (-32.5)	0.047 (-60.83)	0.062 (-48.33)
16 (Days)	0.036 (-70)	0.044 (+6.66)	0.042 (-65)	0.039 (-67.5)	0.051 (-57.5)

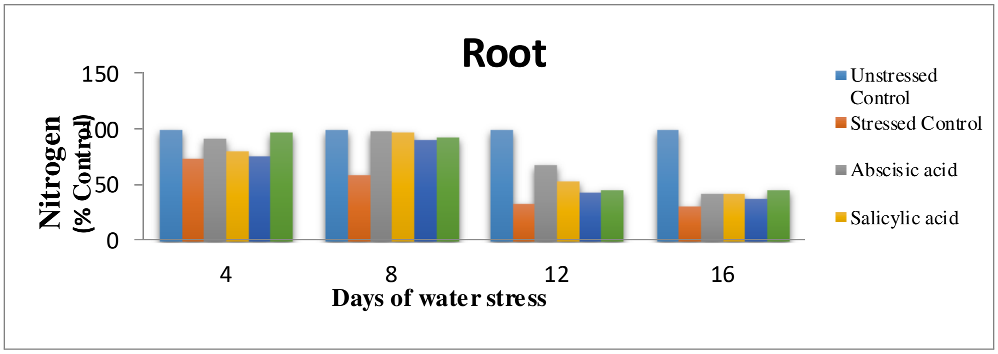
Each value is mean of three determinations.

Values are expressed as **μg NO_2 liberated $h^{-1}g^{-1}$fresh wt.**

Values in parenthesis indicate percent increase (+) or decrease (-) over the control.

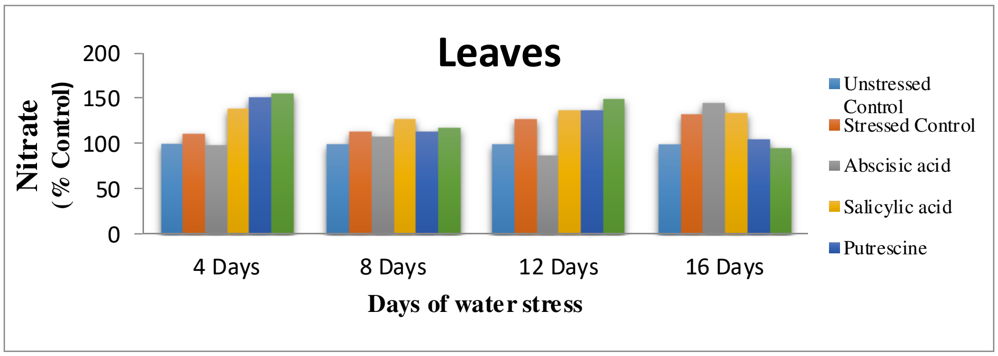


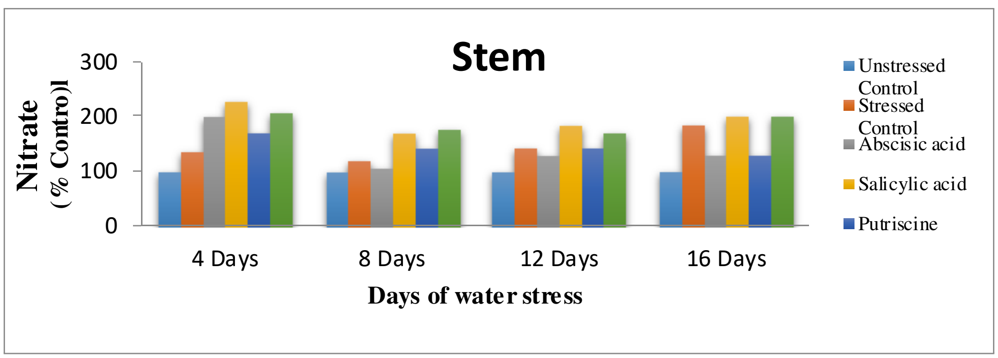


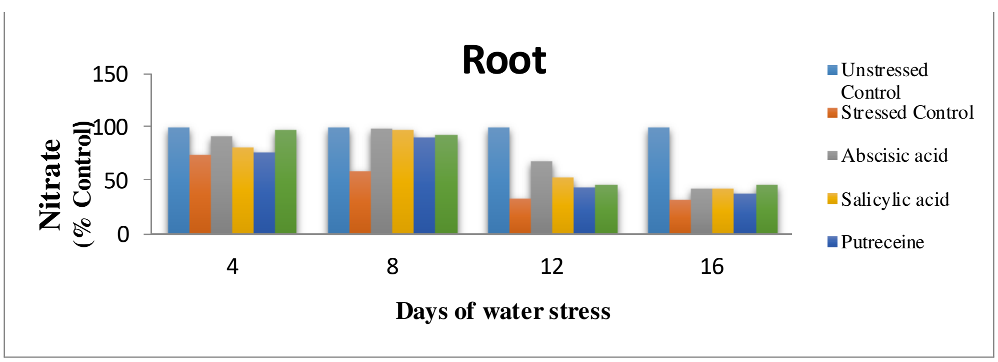


Nitrogen- Unstressed Control- Leaves-0.856 $g100^{-1}g$ dry wt., Stem- 0.323 $g100^{-1}g$ dry wt., Root- 0.327 $g100^{-1}g$ dry wt.

Figure: 1. Effect of foliar sprays of ABA, SA, Putrescine and GABA on nitrogen content of the root, stem and leaves of *S. glauca* grown under water stress.

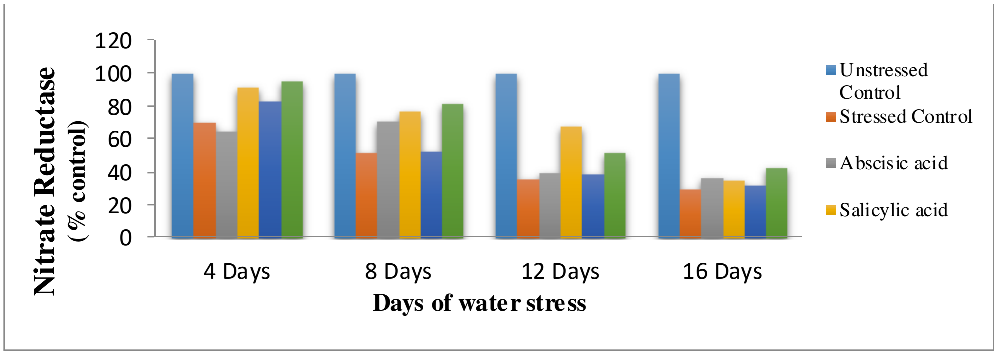






Nitrate- Unstressed Control- Leaves-347.28 $mg100^{-1}g$ dry wt., Stem-43.41 mg100-1 g dry wt., Root-40.31 $mg100^{-1}g$ dry wt.

Figure: 2. Effect of foliar sprays of ABA, SA, Putrescine and GABA on nitrate content of the root, stem and leaves of *S. glauca* grown under water stress.



Nitrate reductase- Unstressed Control- 0.12 µg NO_2 liberated $h^{-1}g^{-1}$fresh wt.

Figure: 3. Effect of foliar sprays of ABA, SA, Putrescine and GABA on the activity of enzyme nitrate reductase in the leaves of *S. glauca* under water stress.

Summary and conclusion:

From the above observation it is concluded that under water stress treatment total nitrogen and nitrate reductase activity were decreased and nitrate content was increased under water stress condition. Exogenous application of these PGRs showed increase in total nitrogen, nitrate, nitrate reductase activity. These results indicate that SA, Putriscine, GABA and Abscisic acid plays a vital role in drought tolerance. It will be helpful to improve the growth and development under stress condition in the medicinally important oil yielding plant *S. glauca.*

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