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ENHANCEMENT IN SEED SET AND SEED YIELD IN *FLEMINGIA SEMIALATA* BY USING PLANT GROWTH REGULATORS

[*]N. K. Sinha, [1]J. Ghosh, [1]V. D. Lohot, [1]Md. Monobrullah, V. P. Bhadana and [2]Brajendra

ICAR- Indian Institute of Agricultural Biotechnology, Ranchi, Jharkhand India
[1]ICAR-Indian Institute of Natural Resins and Gums, Ranchi, Jharkhand India
[2]ICAR-Indian Institute of Rice Research, Hyderabad, Telangana, India
[*]Corresponding author;
E mail:nksinha.cazri@gmail.com

ABSTRACT

The present study was carried out to study the effect of different levels of plant growth regulators on morpho-physiological and biochemical characters and their relationship on yield attributing traits that helps in improving seed set and yield. Plant growth regulators (PGRs) viz., thiourea, naphthaleneacetic acid (NAA), salicylic acid at different levels were sprayed at pre flowering and anthesis stage and their effects were studied on different morpho-physiological, physiological and biochemical characters of *Flemingia semialata*. The experiment was planned under RBD with three replications for each treatment. The different morpho-physiological and biochemical characters were studied at 15 days' interval. Among the ten treatments, NAA 30 ppm recorded highest shoot length, whereas number of raceme/plant, floret number/ raceme, number of pods / raceme and seed set (%) was recorded highest in Thiourea 1000 ppm.

Key words: *Flemingia semialata L., PGR, NAA, thiourea, salicylic acid.*

Plant growth regulators are known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates thereby helping in effective flower formation, fruit and seed development and ultimately enhance productivity of the crops. Growth regulators can improve the physiological efficiency including photosynthetic ability and can enhance the effective partitioning of accumulates from source and sink in the field crops (Solaimalai et al., 2001). Agricultural application of vegetal bio-regulators is becoming a useful practice that has improved the yield of beans, corn and soybean (Vieira and Castro, 2004).

Flemingia semialata is one of the most important leguminous species for intensive *lac* production. Seed yield of this species is quite low because of poor seed set and high rate of seed shattering. Several agronomic approaches have been followed for augmenting higher legume forage yield but a very little work has been done so far on the seed production aspect, especially the shattering of seeds by using plant growth regulators (PGRs). Indeterminate plant growth habit of *Flemingia semialata* causes consequential flowering and seed formation. Poor synchrony of flowering and rapid shattering of ripe seed might be the major cause of its poor seed yield. Keeping in view, the present work was proposed with the objectives to stabilise the seed setting *vis-a-vis* to minimize the seed shattering in *Flemingia semialata* by developing suitable technologies of use of plant growth regulators (PGRs). The objective of this study was to determine the effect of three PGRs namely; NAA, thiourea and salicylic acid on seed-setting and yield components of *Flemingia semialata* under semi-humid climatic condition.

MATERIALS AND METHODS

A field experiments was conducted at the Institute Research Farm of ICAR- Indian Institute of Natural Resins and Gums (formerly Indian Lac Research Institute), Namkum, Ranchi, Jharkhand during 2014-15 and 2015-16. The soil was clay loam in texture with pH of 5.4. In this study, plant growth regulators (PGRs) at different levels (Control (water); thiourea @500 ppm, @ 1000 ppm, @1500 ppm, NAA @ 15 ppm, @ 30 ppm, @ 45 ppm and Salicylic acid @ 100 ppm, @ 200 ppm, @ 300 ppm) were sprayed at pre flowering and anthesis stage and their effects were studied on different morpho-physiological, physiochemical and biochemical characters of *Flemingia semialata*. There were three replications for each treatment and whole experiment was planned under RBD design. The different morpho-physiological and biochemical characters were studied at 15 days' interval. All recommended package and practices of its cultivation was employed. The *F. semialata* were planted on 8th June, 2014 in paired rows of 150 cm apart and 75 cm distance between plants was maintained in a row. The plot area was 21.6 m^2 (6 x 3.6 m).

GROWTH CHARACTERISTICS

Plant height and number of braches/plant were recorded at the time of maturity whereas dry weight/plant and leaf area index were recorded at 15 days' intervals after the treatments.

Yield and its components characteristics

Yield and its components such as number of pods/plant, number of seeds/plant, seed set (%), seed yield were determined at maturity stage.

Estimation of photosynthetic pigments

The blade of the third leaf from tip (terminal leaflet) was taken at 15 days' after spraying to determine photosynthetic pigments (chlorophyll a, chlorophyll b and carotenoids) by the spectrophotometic method recommended by Metzner et al. (1965). Taking into consideration the dilution made, it was possible to determine the concentration of the pigment fraction (chlorophyll a, chlorophyll b and carotenoids) as ug/ml using the following equations:

(1) Chlorophyll a = 10.3 E 663 – 0.918 E 644 = ug /ml,

(2) Chlorophyll b = 19.7 E 644 – 3.870 E 663 = ug /ml,

(3) Carotenoids = 4.2 E 452.5 – 0.0264 Chl. A + 0.426 Chl. B = ug/ml

Where, E is equal optical density at the given wave length

The average data of 3 years were subjected to statistical analysis in factorial randomized block designed as per method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Treatment of different plant growth regulators (PGRs) levels including thiourea (500 ppm, 1000 ppm, 1500 ppm), naphthaleneacetic acid (NAA) (15 ppm, 30 ppm, 45 ppm) and salicylic acid (100 ppm, 200 ppm, 300 ppm) maximum plant height (2.37 m), stem diameter (19.25 mm), leaf area (90.50 cm^2), number of leaves (20.40), number of raceme/plant (11.2), floret number/raceme (152.60), seed set % (67.0), 1000-seed weight (28.4 g) and seed yield (17.6 g/plant) was recorded with the application of thiourea (1000 ppm) (Fig 1).

The percent seed set and pure seed yield were also improved by the application of different levels of PGRs (Fig 2). Maximum seed set (67.0 %) and seed yield (17.6 g/plant) were recorded in the plants treated with thiourea (1000 ppm).

Net photosynthesis rate and leaf stomatal conductance were measured in the fully expanded leaves of *F. semialata* in all the treatments using hand-held photosynthesis system (CI-340 CID, Inc., USA). Photosynthesis was expressed as µmol of CO^2 consumed $m\text{-}^2$ sec^{-1} and stomatal conductance as mmol CO_2 consumed $m\text{-}^2$ sec^{-1} (Fig 3). Among all the treatments, highest net photosynthesis rate (14.68) and leaf stomatal conductance (198.72), as compared to control (8.73 & 83.59), was recorded highest with the application of thiourea (1000 ppm).

Application of different levels of PGRs maintained higher relative water content (RWC) of leaves (56.46 - 42.94 %) and lower water saturation deficit (43.54 - 57.06 %) as compared to control (39.16, -21.68 and 60.84 % respectively).

Thiourea (1000 ppm) recorded highest RWC (56.46%) as compared to control (39.16%). Further, water saturation deficit showed reduction with the application of PGRs in all the treatments (Fig 3). Lowest WSD (43.54) was observed with the application of thiourea (1000 ppm) with respect to control (60.84).

Lowering the water saturation deficit and increasing the relative water content due to the application of PGRs resulted in higher seed set (67.0-63.0 %) as compared to control (60.91 %). The application of PGRs also increased the chlorophyll and carotenoid contents (Fig 4). The highest values (3.14 µg/g fw and 0.52 µg/g fw, respectively) were recorded with the application of thiourea (1000 ppm).

Foliar application of NAA has also found to increase plant height, number of leaves per plant, fruit size with consequent enhancement in seed yield in different crops (Lee, 1990) which is also depicted in the experiment carried out in *Flemingia semialata* Favourable influence of auxins such as NAA has been reported on invertase content of sugarcane (Sacher and Glasziou, 1962; Sacher et al., 1963). The use of growth regulators is considered as one of the way of increasing yield. NAA, a synthetic growth regulator has proved its potentiality that in appropriate concentration NAA affects the growth and yield of a number of plants viz. tomato (Chhonker and Singh, 1959), bitter gourd (Jahan and Fattah, 1991) and cowpea (Ullah et al., 2007). Similarly, Govindan et al., (2000) indicated that soybean plants sprayed with NAA at 40 ppm after 35 days of sowing had significant increases in growth characters, yield and its attributes including number of pods and seeds, plant, seeds/pod and 100 seed weight. Thiourea has been reported to have role in improving photosynthetic efficiency and translocation of photosynthates (Sahu et. al., 1993). Sahu and Singh (1995) reported that thiourea had a significant role in improving dry matter partitioning towards sink in wheat and enhanced metabolic transport of sucrose to the grain via effect on phloem loading. As thiourea plays significant role in dry matter partitioning towards sink, foliar spray of thiourea at heading stage might be useful in improving overall productivity of wheat. Whereas, Salicylic acid is an endogenous growth regulator of phenolic nature, which participates in the regulation of physiological processes in plant, such as stomatal closure, ion uptake, inhibition of ethylene biosynthesis, transpiration and stress tolerance (Khan et al., 2003 and Shakirove et al., 2003). Foliar application of salicylic acid exerted a significant effect on plant growth metabolism when applied at physiological concentration and thus acted as one of the plant growth regulating substances (Kalarani et al., 2002). Salicylic acid also increased the number of flowers, pods/plant and seed yield of soybean (Gutierrez-Coronado *et al*., 1998); enhanced wheat growth (Shakirova *et al*., 2003) and maize growth (Sheheta et al., 2001; Abdel-Wahed et al., 2006; El-Mergawi and Abdel-Wahed, 2007).

Among different plant growth regulators (PGRs) applications in *Flemingia semialata*, thiourea @1000 ppm and NAA @30 ppm were found to be effective in enhancing number of raceme/plant, floret number/raceme, seed set %, 1000 seed weight and seed yield.

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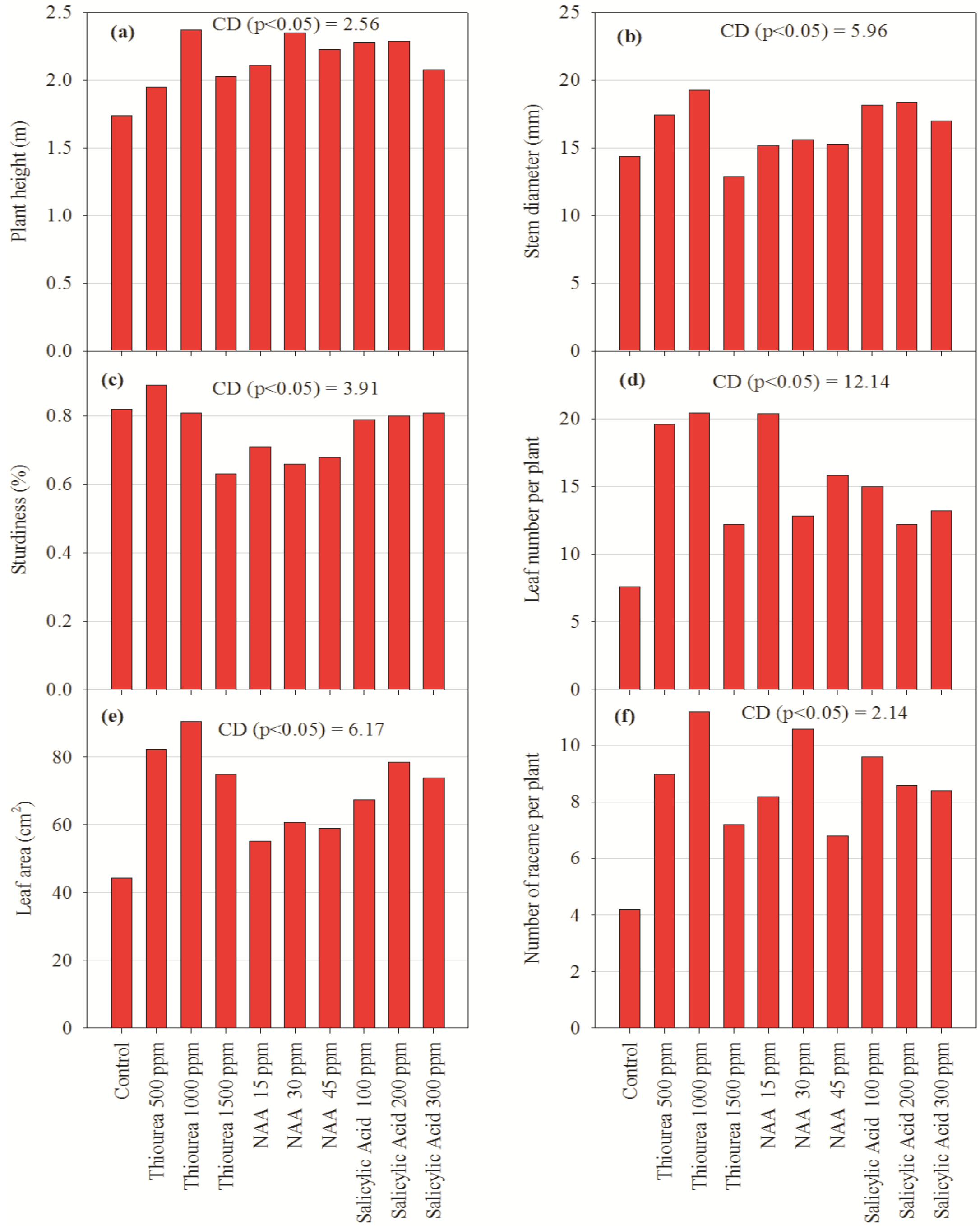

Fig. 1: Effect of plant growth regulators on yield and yield attributes of *F. semialata*

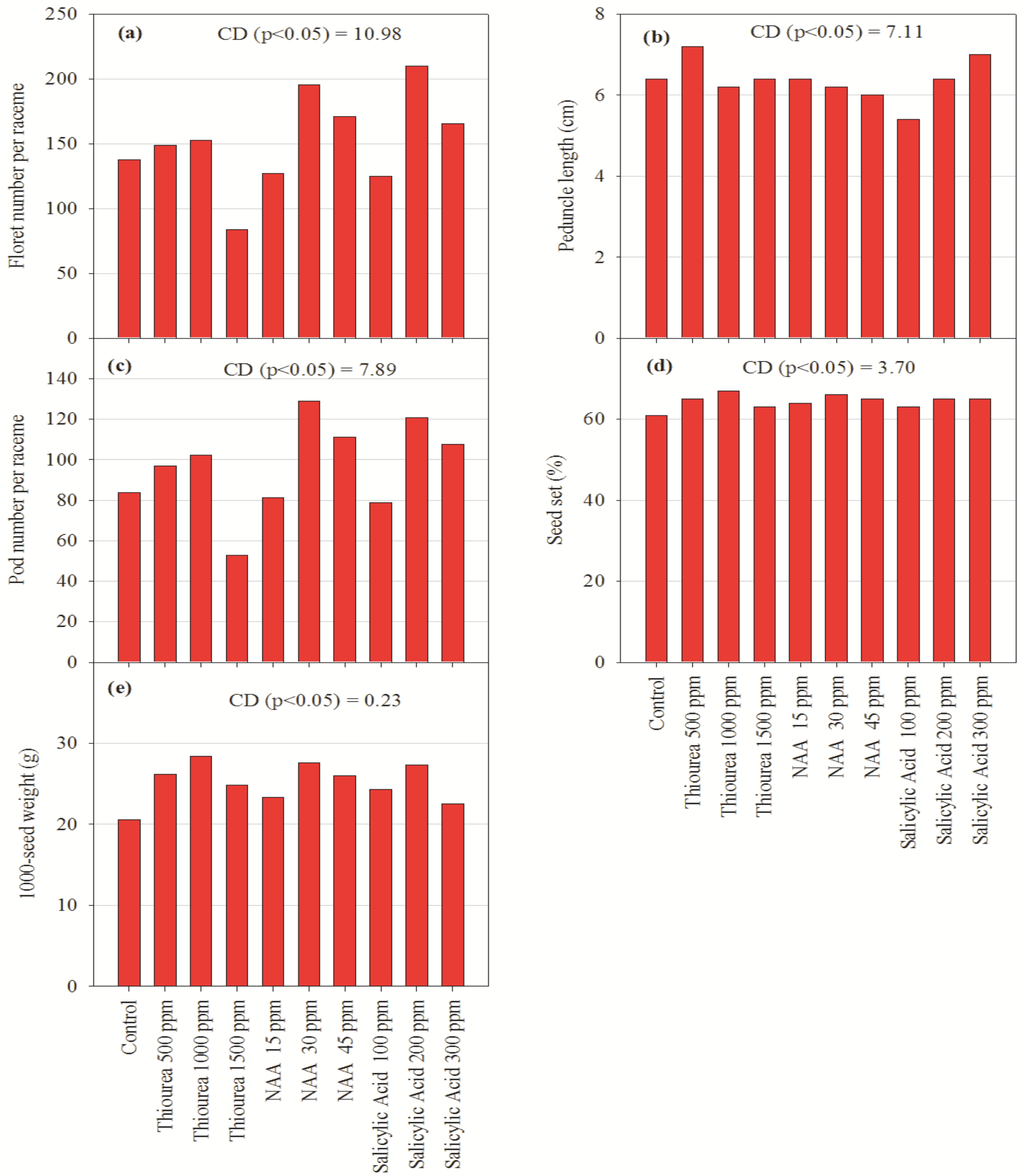

Fig. 2: Effect of plant growth regulators on morpho-physiological character of *F. semialata*

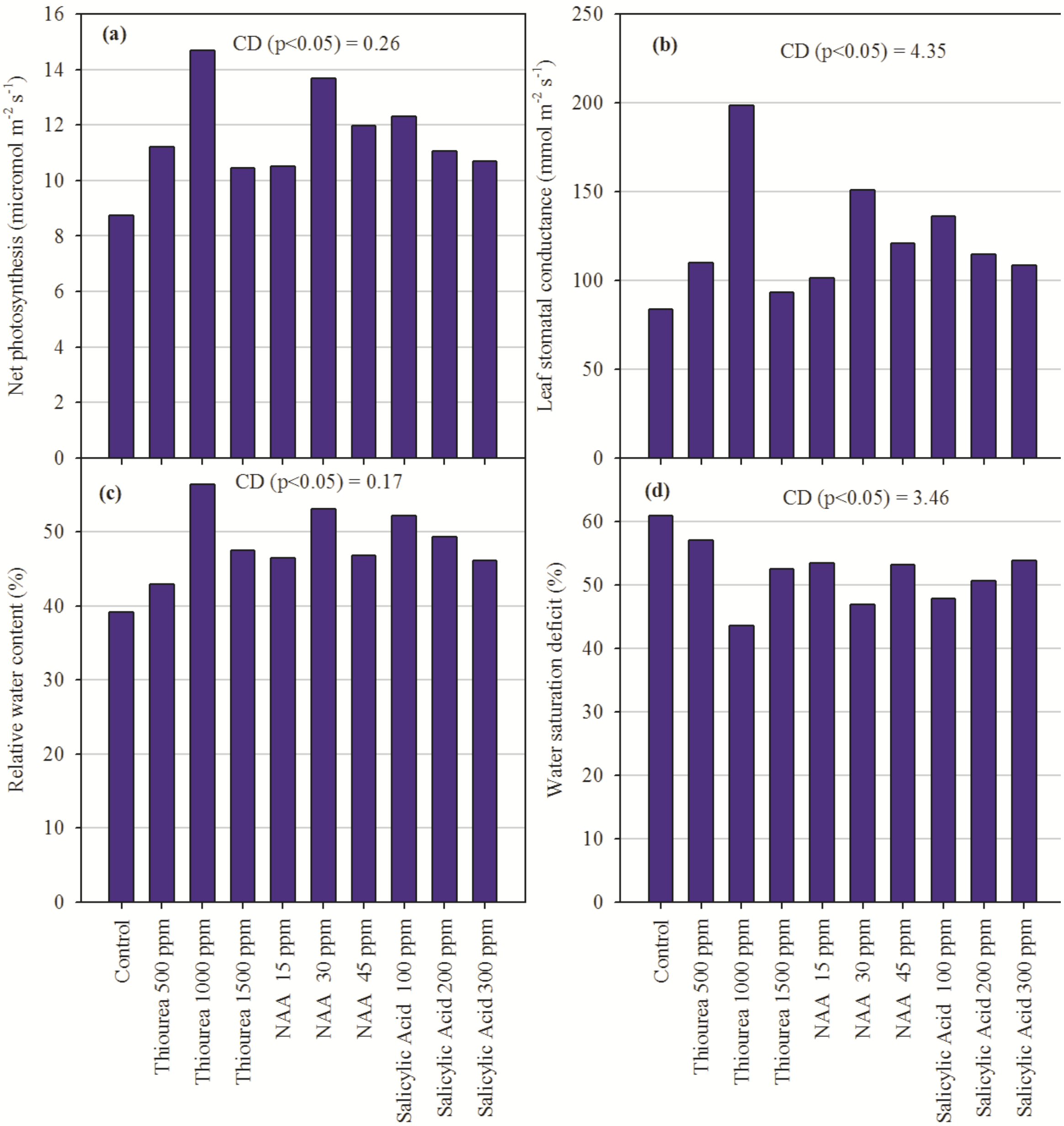

Fig. 3: Effect of plant growth regulators on physiochemical and physiological attributes of *F. semialata*

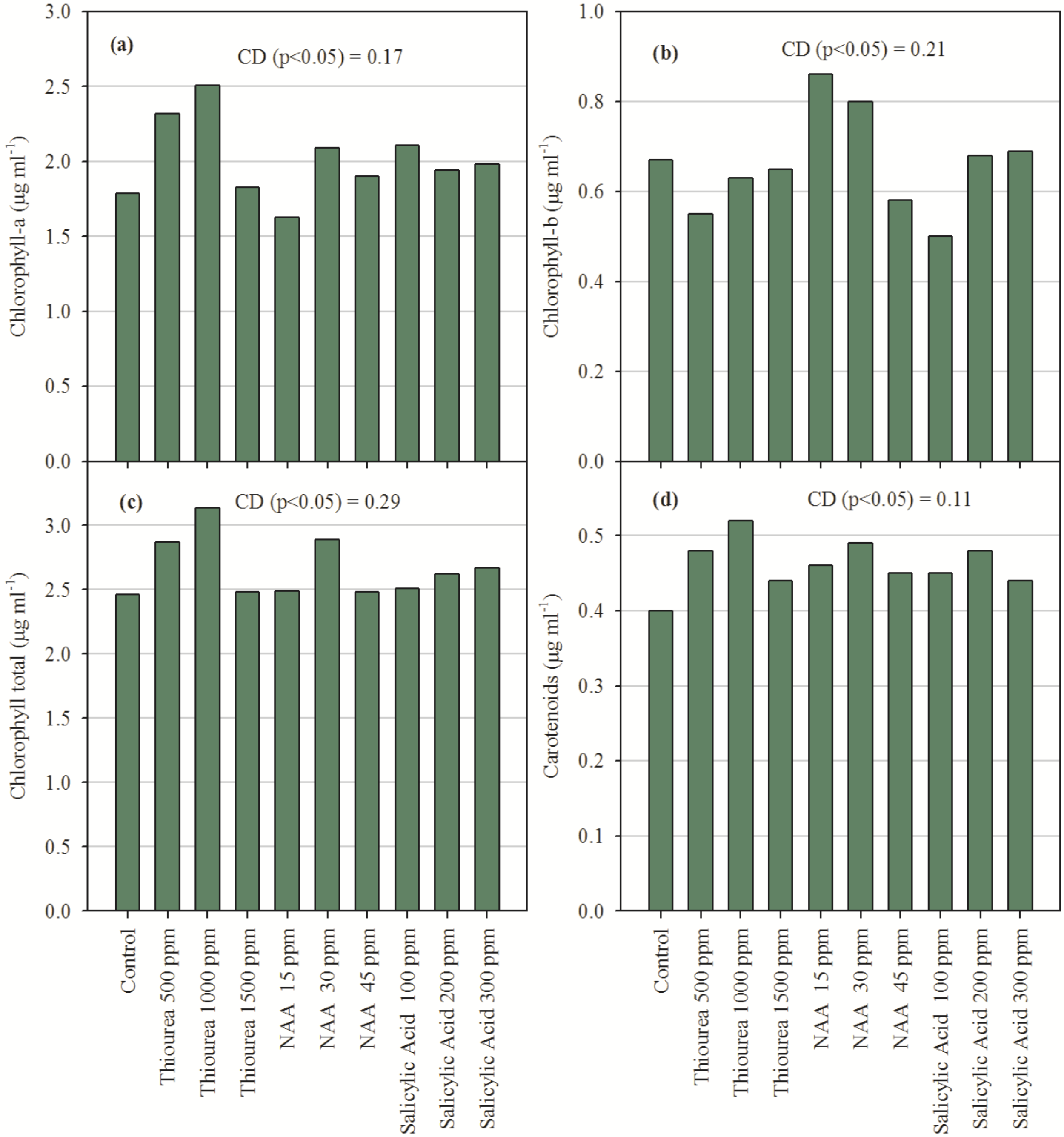

Fig. 4: Effect of plant growth regulators on biochemical attributes of *F. semialata*