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RESEARCH ARTICLE

HOMOBRASSINOLIDE AND SALICYLIC ACID AS POTENTIAL PGRS TO ALLEVIATE CADMIUM STRESS IN GROUND NUT SEEDLINGS

Vasudev, J. and *Vardhini, B.V.

Department of Botany, Telangana University, Dichpally-503322, Nizamabad – T.S., India

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Corresponding author:
Vardhini, B.V.

ABSTRACT

Brassinosteroids (BRs) and Salicylic acid (SA) are considered as the 6th and 7th group of plant growth regulators (PGRs) which have the potential in overcoming different abiotic stresses in plants. The stresses caused by metals and metalloids due to the over industrialization in the recent few years is posing a severe threat to the growth and development of plants. The present article is a brief study on the role of BRs and SA as potential alleviators of cadmium (Cd) stress in ground nut seedlings.

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INTRODUCTION

Homobrassinolide (homo BL), a potential BR and Salicylic Acid (SA) are considered as important PGRs not only capable of regulating growth, development, and differentiation but also possessing the ability to alleviate abiotic stresses in plants (Vardhini, 2019a). The ever increasing threat of abiotic factors like temperature, salt, pollutants, heavy metals etc. directly lead to notable drastic and lethal changes in the overall plant growth and development (Vardhini, 2019b). SA is a PGR capable of positively regulating different physiological processes in plants viz., ion uptake, membrane permeability etc. (Raskin, 1992) and BRs are a novel group of PGRs capable of performing a wide variety of physiological responses like plant growth, seed germination, rhizogenesis, senescence and confer abiotic stresses to plants (Rao *et al.,* 2002). The toxicity symptoms observed in the plants due to the presence of excess amounts of abiotic factors are due to various interactions at the cellular as well as molecular levels (Vardhini and Anjum, 2015; Ali *et al.,* 2018). Heavy metals and metalloid accumulation in the soil, water as well as air is increasing day by day (Anjum *et al.,* 2012). Cadmium (Cd) which is an important heavy metal is negatively effecting the growth and metabolism of plants. The present study is on the role of homoBL and SA in alleviating Cd stress in ground nut seedlings.

MATERIALS AND METHODS

Arachis hypogaea L., var. Kadiri-6 (K-1240) was procured from Regional Agricultural Research Station, Polasa, Jagtial, Telangana State, India. Homobrassinolide (HomoBL) was purchased from Godrej Agrovet Ltd., Mumbai (in the form of Godrej Double). Salicylic acid (SA) and $CdCl_2$ were purchased from Dwarakamai Enterprises, Hyderabad. Seeds were surface sterilized with 0.1% sodium hypochlorite solution and washed thoroughly with several changes of double distilled water. Twenty five seeds were put in each 15cm sterile pertriplates provided with Whatman No 1 filter papers. Seeds were treated in ten different combinations employing homoBL, SA and Cd viz., (i) distilled water (control), (ii) Cd 100µM (iii) Cd 100µM supplemented with homoBL 2µM (iv) Cd 100µM supplemented with homoBL 3µM (v) Cd 100µM supplemented with SA 1mM (vi) Cd 100µM supplemented with SA 2mM (vii) Cd 100µM supplemented with homoBL 2µM and SA 1mM (viii) Cd 100µM supplemented with 3µM and SA 2mM (ix) Cd 100µM supplemented with homoBL 2µM and SA 2mM (x) Cd 100µM supplemented with homoBL 3µM and SA 1mM. Ten ml of the above mentioned test solutions were poured in the petriplates. The plates were kept in dark room at 20 ± 1^0C. Four more ml test solution was added at the end of 48 hours. Germination counts were taken at the end of 48 and 60 hours.

Table 1. Effect of homobrassinolide (homoBL) and Salicylic Acid (SA) on the seed germination percentage of *Arachis hypogaea* L. grown under Cadmium (Cd) stress

Treatments	Percentage of seeds germinated after 48 Hrs	Percentage of seeds germinated after 60 Hrs
Control	32.12 ±1.08	42.00 ±1.41
Cd 100µM	15.57 ±1.32	22.67 ±1.47
BR 2µM + Cd 100µM	19.45 ±1.78	25.00 ±1.04
BR 3µM + Cd 100µM	25.25 ±0.71	30.67 ±1.08
SA 1mM + Cd 100µM	22.74 ±2.11	28.67 ±1.14
SA 2mM + Cd 100µM	30.15 ±1.22	38.33 ±0.54
BR 2µM + SA 1mM + Cd 100µM	31.85 ±1.54	42.10 ±0.71
BR 2µM + SA 2mM + Cd 100µM	35.28 ±0.89	43.67 ±0.45
BR 3µM + SA 1mM + Cd 100µM	38.25 ±0.84	46.67 ±1.25
BR 3µM + SA 2mM + Cd 100µM	34.50 ±0.29	45.67 ±1.85

Table 2. Effect of homobrassinolide (homoBL) and Salicylic Acid (SA) on the seedling growth of *Arachis hypogaea* L. grown under Cadmium (Cd) stress

Treatments	Seedling Length (cm)	Seedling Fresh Biomass (g)	Seedling Dry Biomass (g)
Control	7.12 ± 0.28	2.14 ± 0.05	0.45 ± 0.02
Cd 100µM	3.49 ± 0.35	1.37 ± 0.11	0.22 ± 0.01
BR 2µM + Cd 100µM	4.52 ± 0.74	1.62 ± 0.04	0.28 ± 0.02
BR 3µM + Cd 100µM	5.29 ± 0.26	1.70 ± 0.05	0.32 ± 0.02
SA 1mM + Cd 100µM	4.91 ± 0.51	1.73 ± 0.09	0.30 ± 0.08
SA 2mM + Cd 100µM	6.01 ± 0.29	1.95 ± 0.08	0.38 ± 0.03
BR 2µM + SA 1mM + Cd 100µM	7.25 ± 0.71	2.11 ± 0.07	0.41 ± 0.01
BR 2µM + SA 2mM + Cd 100µM	6.84 ± 0.45	2.45 ± 0.07	0.52 ± 0.01
BR 3µM + SA 1mM + Cd 100µM	7.51 ± 0.58	2.32 ± 0.09	0.47 ± 0.05
BR 3µM + SA 2mM + Cd 100µM	7.35 ± 0.28	2.37 ± 0.07	0.49 ± 0.02

N=9.

Emergence of radicle was taken as criteria of germination. Germination percentage of the seedlings was calculated. After 60 hours, five seedlings were retained in each petriplate and the remaining seedlings were discarded. Another five ml of test solution was added in each petriplate. On the fifth day five more ml of test solution was added. The seedling growth was measured in terms of seedling length, fresh and dry biomass. On the seventh day seedling length was measured employing a meter scale and seedling fresh bio mass was measured by electronic balance. Seedlings were dried seedling in oven at 110^0C for 24 hours and dry biomass was calculated using electronic balance.

RESULTS

Seed germination

The effects of homoBL and SA on seed germination of groundnut subjected to Cd stress are presented in Table 1. The observations indicated that the treatment of Cd significantly decreased the percentage of seed germination in groundnut. Cd 100µM caused maximum decline in seed germination (46%). Application of 2µM homoBL and 3µM homoBL improved seed germination percentage around 10% and 35% compared to seeds exposed to Cd stress. Similarly, application of 1mM SA and 2mM SA improved seed germination around 26% and 69% compared with seed exposed to Cd stress. Co-application of 3µM homoBL and 1mM SA not only ameliorated the inhibitory effect of Cd, but also promoted the seed germination compared to individual PGR-treatments as well as untreated controls.

Seedling length

The effects of homoBL and SA on seedling length of groundnut subjected to Cd stress are presented in Table 2. Treatment 2µM homoBL and 3µM homoBL improved seedling length around 29% and 51%, respectively compared with seedlings exposed to Cd stress. Similarly treatment of 1mM SA and 2mM SA improved seedling length around 40% and 72% compared to seedlings exposed to Cd stress. Co-application of 3µM homoBL and 1mM SA not only ameliorated the negative impact of Cd, but also promoted the seedling length compared to individual treatment as well as untreated controls.

Seedling fresh and dry biomass: The effects of homoBL and SA on seedling fresh and biomass of groundnut subjected to Cd stress are presented in Table 2. The application of 2µM homoBL and 3µM homoBL improved seedling fresh biomass by 18% and 24% and dry biomass by 15% compared to seedlings exposed to Cd stress. Similarly, application of 1mM SA and 2mM SA improved seedling fresh biomass by 26% and 42% and dry biomass significantly compared to seedling exposed to Cd stress. Combined application of both PGRs (homoBL and SA) was more effective than the individual PGR-application in increasing fresh as well as dry biomass compared to controls.

DISCUSSION

Co-application of homoBL and SA not only ameliorated Cd - stress effectively but also improved the percentage of seed germination (46%), seedling growth in terms of seedling length (49%), fresh (64%) and dry(48%) biomass in groundnut more effectively than either homoBL or SA treated independently emphasizing on the usage of PGR combinations in ameliorating Cd stress. Kohli *et al*. (2018) reported that the co-application of 24 –epibrassinolide and SA positively regulated pigment contents, antioxidative defense responses, and gene expression in *Brassica juncea* L. seedlings subjected to lead (Pb) stress. Agami (2013) emphasized on the fact that pre- treatment of SA and 24-epibrassinolide ameliorated the ill effects of salt stress in maize seedlings. Agami and Mohamed (2013) also studied that supplementation of IAA and SA resulted in alleviation of Cd-imposed metal toxicity in wheat

seedlings aptly focusing on the importance of co-application of PGRs in alleviating different abiotic stresses in plants.

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