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EFFECT OF LIGHT AND TWO ISOMERS OF NITROPHENYL INDOLE-2-CARBOXYLIC ACID ON GERMINATION OF *CENCHRUS CILIARIS* SEEDS

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Abstract

Effect of light and different concentrations of m- and p- isomers of 1-nitrophenyl indole-2-carboxylic acid (NPICA) has been investigated on the germination of *Cenchrus ciliaris* seeds. Light not only delayed germination of the seeds but also reduced the germination by ≥62%. Presence of 15 to 45 ppm of either 1-m- or 1-p-NPICA in the germination medium showed a negative effect on seed germination whereas, presence of 30 ppm of either of the two isomers improved germination, albeit slightly and only in the presence of light.

Introduction

Light is known to induce as well as inhibit seed germination process either individually or in combination with other factors (Khan, 1977; Rokich & Bell, 1995). Even within one seed lot individual seeds may have different sensitivities to light. For example, germination of the recalcitrant seeds of *Quercus robur* L., is inhibited by light (Finch-Savage & Clay, 1994). On the other hand, in *Phlox drummondii* Hook., seed germination is not affected whereas the radicle extension in later germination stages is inhibited by light (Carpenter *et al.*, 1993). This sensitivity is because of phytochrome, a photosensitive pigment present in seeds of all species (Yambe *et al.*, 1995).

There are reports of the involvement of various chemicals, mostly carboxylic acids, such as indole acetic acid - IAA, gibberellic acid -GA, abscisic acid present intrinsically or applied to the seed, in the maintenance or breakage of seed dormancy (Ilahi *et al.*, 1987; Simmen & Gisi 1995; Whitehead & Sutcliffe 1995; Yoshioka *et al.*, 1995; Shahid & Soni 1974; Wazir *et al.*, 1991). Their presence in different parts of a mature seed may either block germination producing dormancy or promote germination breaking dormancy (Black, 1992).

Studies have been carried out in understanding the plant seed germination process and to develop techniques that can improve germination of indigenous plant species of Cholistan (Chaudhry & Nasim, 1995, Nasim *et al.*, 1995, 1996, 1997a, b; Ashraf *et al.*, 1997). Many of the species possess some kind of dormancy that needs to be removed through physical or chemical means. Optimum temperature for the germination of *Cenchrus ciliaris*, one of the most common perennial grasses found in

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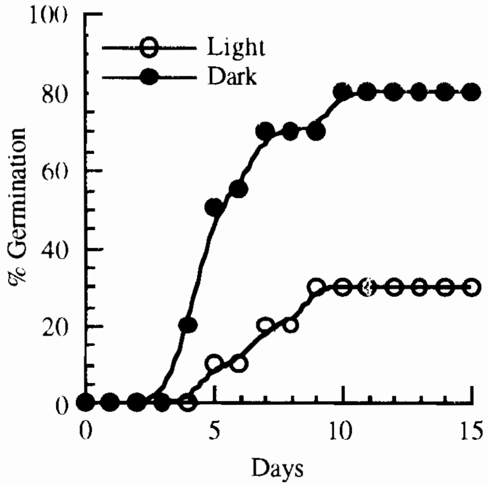


Fig. 1. Effect of light on the germination of *Cenchrus ciliaris* seeds.

the Cholistan desert, is 30°C with a maximum germination of 36% (Nasim *et al.*, 1997a). In an attempt to promote germination of *C. ciliaris* seeds, the effect of light and two isomers of a synthetic carboxylic acid, nitrophenyl indole-2-carboxylic acid (NPICA), was examined which showed that both light and NPICA has an inhibitory effect on seed germination.

Materials and Methods

Two year old *Cenchrus ciliaris* seeds collected from Cholistan (Nasim *et al.*, 1997a) and stored at room temperature in plastic containers at the Cholistan Institute of Desert Studies (CHIDS), Islamia University Bahawalpur, were used. Germination was tested according to the standard protocol (Nasim *et al.*, 1996). Batches of 20 seeds sterilized with 0.2% $HgCl_2$ solution for 3 minutes, washed with distilled water, air dried, were germinated on Whatman No. 1 filter paper in 25 cm diam., sterilized Petri plates which contained 5 ml of distilled water or an equal volume of a 15, 30 or 45 ppm aqueous solution of either 1-m- or 1-p-nitrophenyl indole-2-carboxylic acid (Khan & Rocha, 1977). Germination tests were performed at natural day and night diurnal temperature cycle of 30/25 ± 2°C. Each treatment was replicated 3 times and the effect of each chemical was tested both in presence and absence of light. To test the effect of light one set of Petri plates was placed in a room illuminated with white incandescent light while the other set was placed in loosely folded thick black plastic bag to exclude light. Plates were removed from the dark to note germination only. A measured volume (5 ml) of distilled water was added periodically to the Petri plates. Germination was recorded after every 24 hours for 15 days and emergence of radicle was taken as the marker for germination.

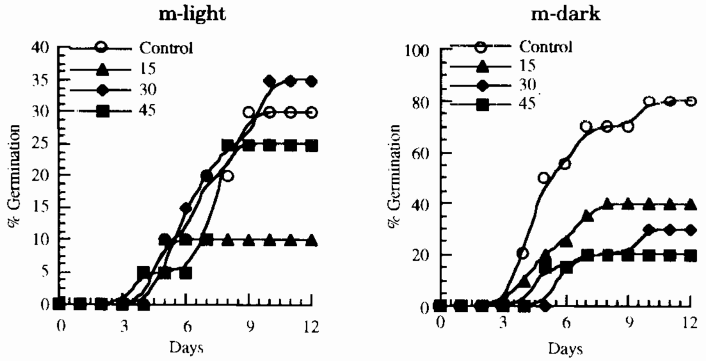
Results and Discussion

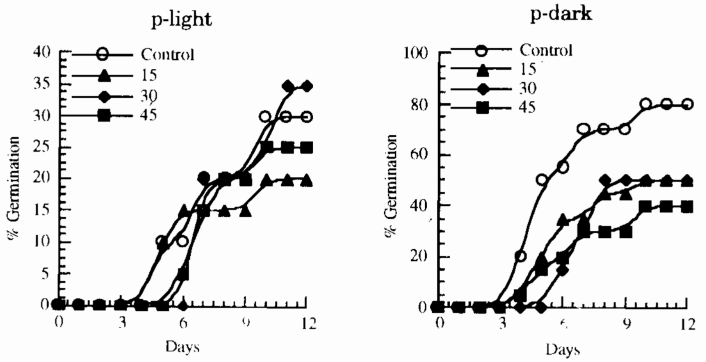
Cenchrus ciliaris seeds were found photoblastic since their germination was inhibited by light (Fig.1) and only 30% seeds germinated in the presence of light while exclusion of light from the germination environment showed a 166.7% increase in the number of germinating seeds under similar test conditions (Table 1). In general, the two isomers of nitrophenyl indole-2-carboxylic acid (NPICA) showed inhibition in germination of *Cenchrus ciliaris* seeds (Fig. 2-4). The effect was more pronounced in the absence of light, except at 15 ppm m-isomer point which showed higher inhibition in the presence of light (Fig. 2,3 and 4 Table I) Both the percentage as well as the rate of germination decreased with increasing concentration of these chemicals and the m-isomer was found to be more potent germination inhibitor. It is interesting to note that in the presence of light (Fig.4) the magnitude of inhibition decreased with increasing concentration of these isomers in the germination medium. Light alone showed a 62.5% decrease in the germination percentage of the seeds while presence of even the least inhibitory isomer, the p-isomer, in the germination medium in absence of light showed 37.5, 37.5 and 50% drop in the germination percentage, respectively at 15, 30 and 45 ppm concentrations (Table 1). On the contrary, when light and p-isomer were combined, not only the maximum inhibition was observed at the minimum NPICA concentration (15 ppm), but also the 30ppm NPICA concentration showed a slightly higher germination over the control (Fig.4). A combination of the two inhibitors, light and NPICA, did not show an additive effect and the 30 ppm solutions of both the isomers were found to stimulate the germination in presence of light although by a small fraction. Similar observations have been reported by several other workers while investigating the effect of various chemicals on the germination of *Oryza sativa*

Table 1. Effect of nitrophenyl indole-2-carboxylic acid (NPICA) isomers on the germination of *Cenchrus ciliaris* seeds in presence or absence of light.

		NPICA concentration (ppm)			
	isomer	0	15	30	45
Maximum germination percentage in presence of light	m	30	10 (-66.7%)	35 (+16.7%)	25 (-16.7%)
	p	30	20 (-33.3%)	35 (+16.7%)	25 (-16.7%)
Maximum germination percentage in dark	m	80	40 (-50%)	30 (-62.5%)	20 (-75%)
	p	80	50 (-37.5%)	50 (37.5%)	40 (-50%)

Values in parenthesis indicate decrease (-) or increase (+) in the germination percentage over the control, the 0 ppm column.





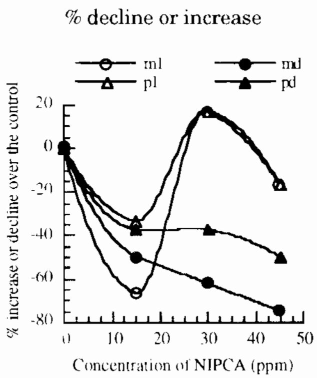


Fig.2. Effect of the m-NPICA isomer on the germination of *Cenchrus ciliaris* seeds in presence (m-light) or absence (m-dark) of light.

Fig.3. Effect of the p-NPICA isomer on the germination of *Cenchrus ciliaris* seeds in presence (p-light) or absence (p-dark) of light.

Fig.4. Effect of the NPICA isomers, in terms of percent decline or increase, on the germination of *Cenchrus ciliaris* seeds in presence or absence of light.

(Shahid & Soni, 1974), *Helianthus annuus* and cotton seeds (Ahmad & Baig, 1974). Although the biochemical details of this inhibition have not been worked out, the results of the present study suggest that the NPICA isomers probably suppress the inhibitory action of light and that the effect is mediated through a unique physiological event. Studies are in progress to elucidate the mechanistic details of the inhibitory action of NPICA molecules on the germination of *Cenchrus ciliaris* seeds.

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