At this stage, microsporangia were connected by central connective tissue which was traversed by a single vascular strand. Similar differentiation was also noticed in *A. theophrasti*[3]. It is interesting to note that in the present investigation, the arrangement of tetrads is isobilateral, whereas in the case of *A. theophrasti*[3] and also in the other members of Malvaceae[4] it is reported as tetrahedral.

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EFFECT OF GIBBERELLIC ACID AND GLUTATHIONE AND THEIR INTERACTION ON FLORAL DEVELOPMENT IN *TRIDAX PROCUMBENS* L.

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TRIDAX PROCUMBENS is a pernicious weed which cannot be eradicated even with weedicides. If flowering can be totally inhibited it is possible to effectively prevent the proliferation of this weed. Earlier work showed that gibberellic acid (GA_3) and glutathione (GSH) together totally inhibited flowering in *Abelmoschus esculentus*[1]. In the same study it was found that GA_3, cysteine, methionine and GSH acted as potent male gametocides. The object of the present study is to test GA_3 and GSH on *Tridax*, based on the earlier observation in *Abelmoschus esculentus* (Bhendi).

Many enzymes and proteins are inhibited/inactivated by sulfhydryl-binding reagents[2]. GA_3 is considered as an activator or inhibitor of protein synthesis acting at the translational level[3]. Since specific proteins are associated with floral development, these chemicals were selected for the present study. Neither *Tridax* nor *A. esculentus* is photoperiod-sensitive. This is an experimental study on the chemical control of floral development.

Seeds of *T. procumbens* were dried in sunlight for 6 h and sown in 9" pots. When the plants were 15-days-old, GSH and GA_3 separately and in combination at a concentration of 200 ppm each were applied as a foliar spray. The plants were sprayed every week till flowering (four sprays). Lower concentrations, viz. 10, 50 and 100 ppm were found to be ineffective. Floral morphology of the inflorescence was studied at 45 days by noting the size of the inflorescence, numbers of disc and ray florets, number of stamens, and nature of the gynoecium. Viability of the pollen was tested by 0.5% acetocarmine staining[4].

The results (figure 1 and table 1) indicate that the size of the inflorescence (in terms of length) was significantly reduced in plants treated with GSH or GA_3 alone, the reduction being more prominent in the latter case. Petal formation was totally inhibited by GA_3 treatment (figure 1). It has been reported[5] that corollas of female *Begonia* flowers were inhibited by gibberellins. The size of ray flowers (female) as well as disc flowers (bisexual) was also reduced after either treatment. Ray flower formation was totally inhibited by GA_3 treatment. The promotion of ray flower growth in *Gaillardia* by application of gibberellins has been reported[6]. Thus the response to gibberellins appears to differ in different plants.

It is interesting to note that while GA_3 totally suppressed corolla formation its interaction with GSH caused a significant increase in corolla size (figure 1). As opposed to this a significant increase in corolla growth was reported in *Gaillardia*[6].

Male sterility was induced in disc florets by GA_3 and its interaction with GSH (table 1). Earlier work on corn[7] and *Hibiscus esculentus*[1] indicated male gametocidal effect of GA_3.

Interaction of GA_3 with GSH caused a significant increase in the size of both ray and disc flowers (figure 1). While GA_3 brought about an increase in the number of disc flowers (control 24, GA_3 32), interaction with glutathione caused a drastic reduction (3) (table 1). GA_3 alone suppressed female flower production (female gametocide), while the combination of GA_3 and GSH caused a significant reduction in bisexual flowers. Thus the ultimate goal of finding chemicals other than weedicides for preventing weed proliferation is partly fulfilled by the present investigation. GA_3 and GSH appear to

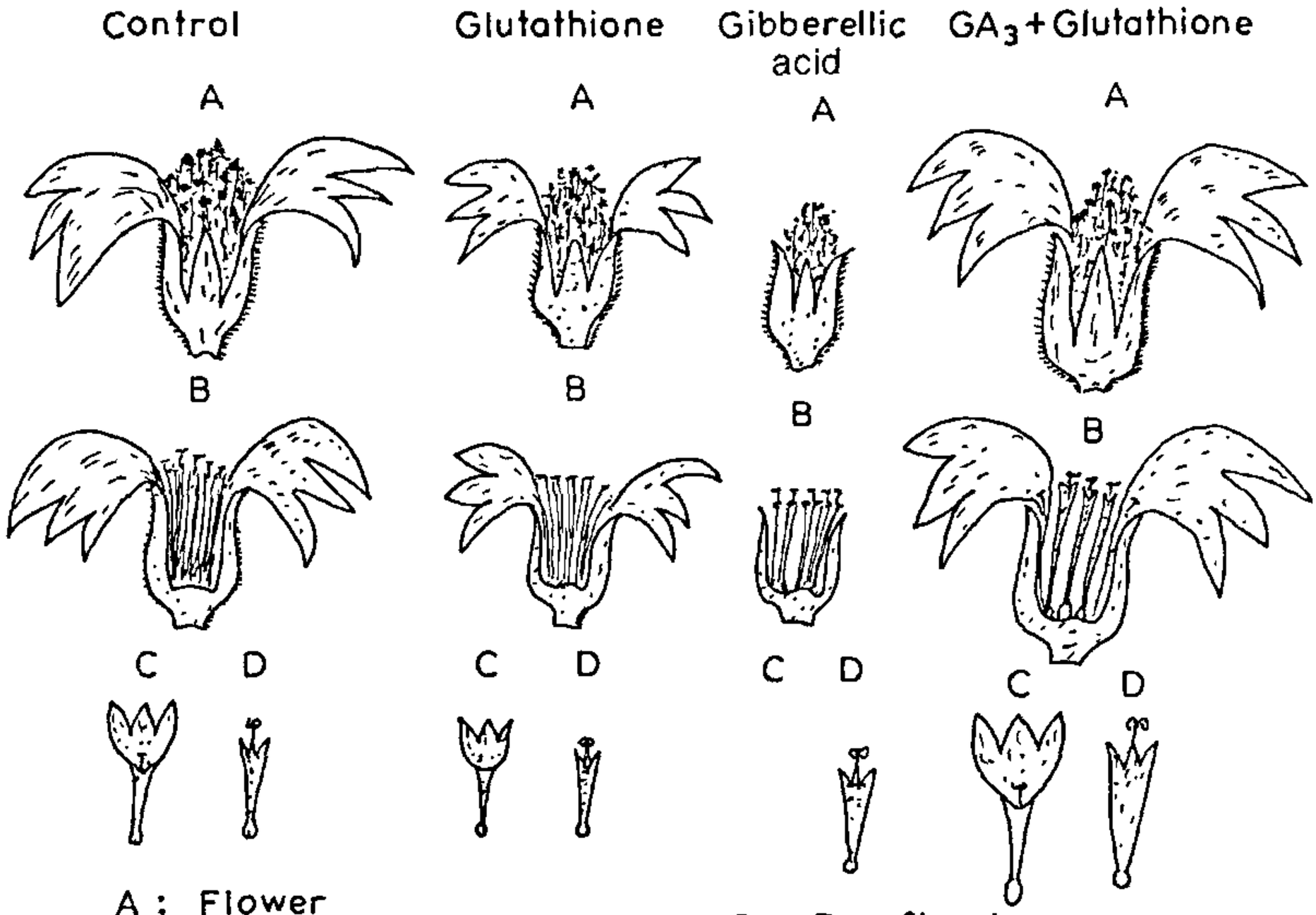

Figure 1. Effect of glutathione and gibberellic acid and their interaction on the floral morphology of *Tridax procumbens* L.

Table 1 *Effect of glutathione and gibberellic acid and their interaction on the floral morphology of Tridax procumbens L.*

		Disc floret			Ray floret	
Treatment	Length of inflorescence (cm)	No. of disc florets per inflorescence	No. of stamens per disc floret	Nature of gynoecium	No. of ray florets per inflorescence	Nature of gynoecium
Control	1.2 (0.2)	24 (0)	5 (0.4) Fertile	Normal	5 (0.2)	Normal
GSH (200 ppm)	1 (0.2)	20 (0.5)	5 (0.4) Fertile	Normal	6 (0.2)	Normal
GA_3 (200 ppm)	0.7 (0.1)	32 (0.2)	5 (0.5) Sterile	Normal	—	—
GSH (200 ppm) + GA_3 (200 ppm)	2 (0.2)	3 (0.4)	5 (0.5) Sterile	Normal	5 (0.5)	Normal

Values in parentheses are CD at 5% level.

act on proteins associated with differentiation of floral parts. Chemicals which can totally inhibit flower formation are few[8].

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HUMIC ACID INDUCED REVERSAL OF RETARDING EFFECT OF MORPHACTIN IN *ERUCA VESICARIA* (LINN.) CAV. SUBSP. *SATIVA* (MILL.) THELL

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HUMIC acid is a complex material formed in the soil[1]. It acts as potent auxin[2] and enhances seedling growth, chlorophyll biosynthesis[2,3], uptake of nutrients by plants[4], and has been reported to antagonize the effect of growth inhibitors[2–5]. Morphactin, a synthetic growth regulator, affects all phases of plant growth and development biochemically and morphologically[6]. The present study was undertaken to see the effect of morphactin on *Eruca vesicaria* (Linn.) Cav. subsp. *sativa* (Mill.) Thell, and the influence of humic acid *on this* effect.

Seeds of *E. vesicaria* subsp. *sativa* were germinated under continuous light from a single incandescent tubelight at 30 ± 2°C in sterilized petri dishes lined with Whatman No. 1 filter paper moistened with distilled water (control) or different concentrations of test solutions or with a mixture of equal volumes of 100 mg/l humic acid (humic acid sodium salt, Aldrich make) and morphactin solution of 5, 10 or 25 mg/l. The concentration of humic acid used (100 mg/l) was found to be the best for seedling growth and chlorophyll biosynthesis in preliminary trials using concentrations of 25, 50, 100, 200 and 300 mg/l. Three replicates of 20 seeds were used each time and the experiments were repeated five times.

Forty mg of fresh cotyledonary leaves were extracted with 80% acetone and the optical densities of the extract supernatant at 470 nm and 660 nm were determined using a photoelectric colorimeter, for carotenoids and chlorophylls respectively[7].

A concentration-dependent retardation of germination and seedling growth was caused by morphactin treatment (table 1). The usual phenomenon of root coiling disappeared after morphactin treatment. The formation of lateral roots was also inhibited but increase in density of root hairs was observed in treated seedlings. After 36 h of germination, interestingly, radicles of morphactin-treated seedlings became negatively gravitropic while in control roots remained normal. Lower concentration (5 mg/l) of morphactin showed little or no effect on gravitropic response. The levels of chlorophylls and carotenoids were very much reduced by morphactin treatment. Dry weights of seedlings also decreased in the same manner. Humic acid alone promoted linear growth of seedling, formation of carotenoids and chlorophylls and dry matter production. In combination treatments, humic acid showed antagonistic effects on morphactin and nullified the growth-retarding effect of morphactin to some extent.

It may be inferred that morphactin has a novel type of action, mainly straightening the twisting nature of the radicle. This may be due either to abolition of the polarity phenomenon[5,8,9], i.e. polar orientation of cell division, or to interference with metabolism, or to effects on transport and distribution of endogenous phytohormones[5,6]. Morphactin also increased the density of the root hairs, apparently increasing the absorbing surface of roots[5,10].