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ROLE OF CHEMICAL HYBRIDIZING AGENTS (CHAs) IN TWO LINE HYBRID RICE DEVELOPMENT

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Some species are subjected to the temporary induction of male sterility using a variety of compounds known as chemical hybridising agents or by other names (such as male gametocides, male sterilants, pollenocides, androcides). Auxins and antiauxins, halogenated aliphatic acids, gibberellic acid, etheophon, DPX-3718, arsenicals (MSMA, DAA, ZMA, etc.), RH-531, RH-532, and others are examples of this type of chemical. Utilizing these substances causes male sterility in plants, requiring cross-pollination. Different products have varying levels of effectiveness. A chemical hybridising agent (CHA) is a substance that makes male plants artificially and non-genetically sterile so that they can be used as the female parent in the creation of hybrid seeds. Male sterilants, selective male sterilants, pollen suppressants, pollencide, and androcides are some of their other names. These chemicals have an impact on the operation of the male reproductive organs of plants. Because the main goal of the entire process is to produce a hybrid, the term "chemical hybridising agents" (CHA) is used. In order to produce hybrids, a handful of CHAs have been documented to sterilise males. Since maintainer and restorer lines are not required, time, work, and money are saved. Various features of CHA, such as its optimal qualities, mode of action, application to different gametocides in rice, and employment in the creation of two line hybrids, are covered in the present study.

Properties (Features) of an ideal CHA

1. Sterility is induced through a broad-spectrum effect in the sequentially rising panicles.
2. Selective and complete stamen sterilisation that has no impact on ovular fertility
3. Less phytotoxic, noncarcinogenic, and devoid of any lingering toxicity that might endanger people or animals.

4. Not allowed to be mutagenic
5. In the F1 seed, must not have carried over.
6. Must reduces seed set reproduction to a minimum.
7. Must regularly result in total male sterility.
8. Be affordable and simple to implement.

Action Style

The following are the main disruptions that ultimately lead to malfunctioning male gametes:

1. Meiosis disruption causes pollen mother cells (PMC) or curly microspores to degenerate and to stop developing.
2. Exine development is disturbed, resulting in thin-walled, crooked, and non-viable micropores.
3. Starch deposition is reduced, and aberrant vacuoles form inside the micropores, rendering them non-viable.
4. Tapetal layers' persistence and irregular development
5. Anthers that are normally formed but do not dehisce or do so with visible pollen
6. Pollen not germinating on the stigma or the pollen tube no longer extending, preventing fertilization

Various Gametocides Treatment in Rice

Zinc methyl arsenate (CH:AS03 Xn HP) was employed in different concentrations (30, 40, 50, and 60 ppm) by Huang Qun-Ce and Wang Li-Zhu (1990) to induce male sterility in a population of the CIS 28-15 TGMS line that was only partially male sterile. They claimed that by spraying five days before to heading, when the pollen is in its exine stage, full pollen sterility could be achieved in all concentration levels. In India as well as other parts of the world, the successful commercial production of hybrid rice in China has generated substantial interest in research and heterosis breeding. However, the fragility of the CHA line in Indian environmental circumstances rendered it difficult to take advantage of the hybridization effort. Gametocides are capable of working in these circumstances.

Three partially sterile CMS lines, V20 AIR 54753A and IR58053A, as well as a typical fertile variety, BPT 1235, were utilised by Sathyanarayana et al. (1995) to induce total male sterility using three male gametocides, namely ethrel, sodium methyl arsonate (SMA), and natriumarsonate. They claimed that SMA at 500 ppm in the genotype IR 54754A was discovered to be the best therapy among the available options since 100% pollen sterility could be attained with the least amount of phytoxicity. More plant damage was caused by lower plant height and shorter panicles at higher chemical concentrations.

Gangarao *et al.*, (1996) investigated how four chemicals affected rice and found that ethrel was the most successful in causing pollen sterility (94–95%) at 10,000 ppm. At 600 ppm, natrium arsenate was found to produce 49.9% sterility. They claimed that the other chemicals tested—TIBA and streptomycin—were less successful. Further research in this area would be very beneficial to standardising the chemical hybridization technique as an addition to the three line breeding scheme.

Uses of CHA to Develop Two Line Hybrids

Chemically Induced Male Sterility

Chemical hybridising agents (CHAs), which have the ability to produce hybrid rice seeds, have been the subject of attempts since the early 1970s. Ethylene-releasing substances, extremely carcinogenic arsenic substances, and growth hormones are only a few of the chemicals that have been explored thus far. In commercial hybrid seed production, gametocides were likely exclusively utilised in China, but their use has since decreased due to research showing that they are harmful to human health. When rice hybrids created with CHAs were evaluated alongside 3-line bred hybrids, the results showed that the yields were frequently greater and regularly equivalent. Over time, seed yields have increased from 0.4 t ha-1 with 40–60% seed purity to 1.5 t ha-1 with 80–90% seed purity. Total male sterility must be selectively induced by CHAs. The application of CHAs should occur at the stage of stamen and pistil primordia production or stage IV to maximise their impact (i.e., the gametocidal effect varies from variety to variety). Oxanilates were discovered to be successful in India when sprayed on rice plants at stage IV (the meiotic stage), and variety Pusa 150 was sterilised more efficiently by the gametocidal spray than other varieties, demonstrating genotype specificity (Yogendra Sharma and S.N. Sharmal 2005). Any cross between two heterotic parents can be utilised to directly produce hybrid seeds. For instance, in the 8:2 ratio, Y2 and X2 are employed as male and female seed parents, respectively, for the generation of commercial hybrid seeds by chemically treating the seed parent, excluding the female reproductive system and only influencing the male reproductive system. Therefore, any disruption of the tapetal layer (pollen grains) results in male sterility. Even excessive tapetal cell protrusion crushing microspores has been known to result in sterility

(Frankel and Galun, 1977). Since the tapetal cells that surround the forming pollen cells act as a route for nutrition, they are crucial to the development of pollen grains. More plant damage was caused by lower plant height and shorter panicles at higher chemical concentrations.

Benefits of The Two-Line Approach through CHA

- Superior hybrid combinations can be created using a wide variety of types.
- The process of making seeds is less complicated than three-line breeding because it does not call for the creation of three lines (A, B, and R).
- If the non-synchronization of blossoming or persistent rain prevents the CHA from being effective,
- The production of the sprayed unaffected female would still be sufficient during the critical stage, preventing huge crop losses.
- A spray of an appropriate CHA can totally sterilise partial CMS lines and EGMS lines.
- In CHA derived hybrids, the problem with the three-line rice hybrids' limited genetic basis for cytoplasmic genic male sterility is no longer present.

The Drawbacks of CHAs

- The production of impure hybrid seeds in the event that the CHA is unsuccessful due to bad weather or unsynchronized tillering and development.
- Health risks associated with some CHAs (such as zinc methyl arsenate or sodium methyl arsenate).
- The chemicals are very expensive.

The potential value of gametocide as a breeding technique has already been alluded upon. Their ability to create hybrid seeds in kilogramme amounts rather than the typical gramme quantities achieved by conventional hand crossing producers is maybe their greatest benefit in this two line breeding.

Conclusion

Allusions have already been made to the possibility that Gametocide can be important breeding tools. The relative ease with which kilogramme quantities of hybrid seeds can be produced using chemical hybridisingagents techniques, as opposed to the gramme quantities typically obtained by conventional methods, may be their greatest advantage in this context. However, it is clear that, despite their inherent benefits, research on the development of those benefits created a virtual vacuum for gametocidal research during the past. However, in recent years, numerous foreign corporations have tested and created proprietary sterility inducing hybridising agent's proprietary sterility inducing hybridising agent's proprietary sterility inducing hybridising agents to public and seed company breeders. As a result, there is a dearth of published data on the newest compounds. Research an effort needs to be intensified in research stations to develop efficient gametocides and their potentials needs to be realised.

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