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他殖性作物における突然変異体の誘発・選抜法の開発
—花粉照射を用いたキュウリの芽生突然変異体の誘発—
A method to obtain mutants in outcrossing crops.
—Induction of seedling mutants in cucumber using pollen irradiation.—

種子繁殖性作物における放射線育種は主にイネ、オオムギ、トマトなどの自殖性作物に限られており、他殖性作物での適用例は少ない。他殖性作物では「穂別系統内交雑法」(本テクニカルニュースNo.25)が開発されているものの、果菜類として重要なものが多く含まれているウリ科作物には適用し難い面があり、従来ウリ科作物に対する放射線育種はほとんど発展していなかった。

ウリ科作物は雌花と雄花が1株内に別々に開花し、虫媒によって受粉が行なわれるが、人工受粉によって自殖させることも可能である。しかし、自殖性作物に多く適用されているように種子に放射線を照射しても、ウリ科作物では雌花と雄花が同一突然変異組織に着花して自殖受粉され、変異体が分離してくることは期待し難い。この問題点を解決する方法として花粉に放射線を照射することを考案した。モデルケースとしてキュウリ（品種にしき四葉）を用いた。開花前日にクイックタイで花弁を雌花、雄花とも閉じておき、開花当日の朝に雄花をガンマーホットセルで1kRから10kRまで照射し、雌花に交配した。得られた種子を1粒1系統として栽培した。この段階では、突然変異体は表われないが、もし照射花粉に突然変異が生じていればその株は全身が突然変異遺伝子をヘテロに持つ細胞で構成されていることになる。したがって、この株内では自殖交配すれば次代で突然変異体が分離することが期待される。この自殖交配を行なって得られた種子を1系統づつ播種したところ、芽生検定で8系統の突然変異体を得ることができた（表－1）。

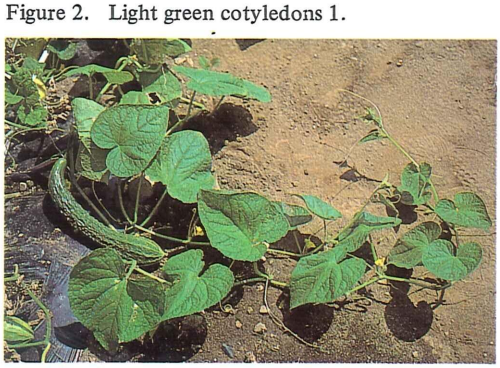
なお、これらの芽生変異体の外に、一部を圃場栽培したところ、五角形状をしている葉の角がなくなりハート状の丸葉になった突然変異体も選抜することができた。この花粉照射法での、適正と思われる照射線量は2kRから4kRの範囲であった。

（飯田修一、天野悦夫）

第1図　白色子葉
Figure 1. Albino cotyledons.

第2図　淡緑子葉1
Figure 2. Light green cotyledons 1.

第3図　緑縁波形白色子葉
Figure 3. Green and wavy rimed white cotyledons.



第4図　ハート型丸葉
Figure 4. Round heart leaves.

表－1　ガンマー線照射花粉の交配後、自殖1代を経て検出されたキュウリ芽生突然変異体

Table-1. Cucumber seedling mutants segregated in selfed progenies after cross with gamma-irradiated pollen.

変異形質 Mutant trait	照射線量（kR） Irradiation dosage	分離比（変異体数／発芽数） Segregation ratio (Mutant/Total)	形質詳細 Details of mutant characters
緑縁波形白色子葉 Green and wavy rimed white cotyledon	2	17/66	子葉展開時には中央部分が白く、周縁部が緑色。その後、子葉の中央部分は緑色になり波を打つ。本葉は正常。 Center of cotyledons were white and rims were green. Later, central part became green, and rim of cotyledons took wavy form. Leaves were normal.
白色子葉 Albino cotyledon	2	10/56	子葉は完全に白いが、胚軸は薄緑。 Cotyledons were white but hypocotyl was light green.
角型子葉 Horn like cotyledon	2	17/57	子葉が牛の角の様にそりかえる。本葉も奇形。茎の断面が丸い。 Cotyledons were warped like a bull horn. Leaves were also deformed. Transverse section of stem was circular.
矮性1 Dwarf 1	2	15/51	子葉はやや小型である。胚軸は短く、本葉はごく小さい。 Cotyledons were small and the hypocotyl was short. Leaves were very small.
矮性2* Dwarf 2	2	4/49	同　上 Same as above.
淡緑子葉1 Light green cotyledon 1	4	11/57	子葉は展開時には淡緑色。本葉も展開時には淡緑色で後、正常な緑色になる。 Initially, cotyledons were light green and young leaves were also light green. Then they truned to normal green.
淡緑子葉2 Light green cotyledon 2	8	11/44	同　上 Same as above.
縮れ本葉 Shrunken leaves	4	10/50	第一本葉が縮れている。二葉以降はしだいに正常形となる。 The first leaf showed shrunken shape but later leaves progressively turned to normal.

*：圃場栽培で雄性不稔個体(雄花落花)を分離した。
Also, male sterile plants were segregated in the field.

The use of induced mutations for improvement of seed propagating crops has so far been confined to inbreeding species. Only a few research for improvement for outbreeding species has been done. "Crossing-Within-Spike-Progeny method" was developed for outbreeding species (This Technical News No.25), but it is difficult to apply to Cucurbitaceae plants which contain important crops. This might be the reason that mutation breeding has not been developed in Cucurbitaceae crops as a major breeding technique.

In Cucurbitaceae crops in which male and female flowers are developed separately on a plant and pollinated entomophily, but it is possible to self-pollinate them artificially. In case of seed irradiation, as applied in many inbreeding species, mutated tissues may distribute in a chimeric pattern, even if artificial pollination is used within a plant, segregation of mutants will not occur.

To break through the problems, pollen irradiation was examined as mutagenic treatment. Cucumber (*Cucumis sativus* L. var. Nishikisuyo) was used as a model. The petals of male and femal flowers were closed by pinching with binding wire on the previous day of flowering to prevent pollination by insects. On the flowering day, the male flowers were collected and irradiated with 1kR to 10kR of gamma ray in a "Gamma Hot Cell", then used to pollinate the female flowers. The seeds thus obtained were sown and transplanted to a field.

In this generation, no mutant phenotype were appeared. However, if a mutation was occured in the pollen, entire tissues of the resultant plant might be consisted of a single heterozygous genotype. In such a condition, selfing pollination within a plant will lead to segregation of mutants in the next generation. Actually, the seedling examination of these selfed lines revealed eight seedling mutant lines (Table-1). A mutant line, in which shape of fully grown leaves changed from original pentagonal shape to round heart shape, also found in the field cultivation.

The optimal irradiation dose for this method might be between 2kR and 4kR. (S. Iida and E. Amano)

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