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Inheritance of sex expression and fruit shape in melon (*Cucumis melo* L.)

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Abstract
Sex expression and its related trait, fruit shape were studied in inter-botanical cross combinations of melon landraces, wild type and cultivated varieties with various fruit shapes and two distinct sex forms. The nine parents and their 18 F_1 hybrids, F_2 and back crosses of two of the selected cross combinations of oblate, andromonoecious X oval, monoecious and oblate, andromonoecious X cylindrical, monoecious were evaluated for sex expression and fruit shape. All the hybrids of andromonoecious X monoecious parents resulted in all monoecious hybrids with intermediary fruit shape. Andromonoecious hybrid was observed only when both the parents were andromonoecious. Crosses between round fruit type (IC632181) and oblate shaped fruited parents, both with andromonoecious nature resulted in hybrids with round fruits. The Chi square analysis for goodness of fit was non- significant for both sex expression and fruit shape suggesting the dominance of monoecious over andromonoecious and incomplete dominance for fruit shape for oblate X oval and cylindrical fruit types.

Keywords: *Cucumis melo L.,* sex expression, fruit shape, melon breeding, andromonoecious, monoecious

Introduction
Melon (*Cucumis melo* L.) is a member of the *Cucurbitaceae* family. It is diploid with chrmonososme number 2n = 2x = 24. The species *melo* includes dessert types (*momordica, cantalopensis, reticulates, ameri, inodorus, indicus, makuwa, adana, chandalak, chinensis, ibericus* and *casaba* and vegetable types (*conomon, acidulus, flexuosus, tibish, chito* and *kachri*). Among the vegetable types there are cooking, pickling and salad types (Pitrat, 2016; Manchali *et al*., 2021) [1, 2].
Melon botanical groups have three types of flowers (male, female and hermaphrodite or perfect) and diversified sex forms (Poole and Grimball, 1939) [3]. Wild and many landraces of melons are usually monoecious with male and female flowers on the same plant. Majority of the improved cultivars are andromonoecious bearing male and hermaphrodite flowers on the same plant (Pitrat, 2008) [4]. Genotypes with only perfect/ hermaphrodite flowers are very few (Kubicki, 1969) [5] and dioecious (male and female flowers on different plants) are not noticed in melon (Pitrat, 2008) [4]. Gynoecious sex forms (Kenigsbuch and Cohen, 1990) [6] and gynoandromonoecious (pistillate, staminate and perfect) are also noticed but not very common (Munshi and Alvarez, 2005) [7]. Staminated (male) flowers are borne in clusters and appear prior to female or hermaphrodite flowers, whereas, pistillated flowers are solitary in nature. Melons are highly cross-pollinated due to different sex forms and cross compatibility among botanical types (Chaitra, 2019; Choudhary *et al.*, 2019; Rashmi, 2023) [8, 9, 10] and these two factors have resulted in the emergence of many intermediate botanical types (Pitrat, 2016) [1]. Self-incompatibility is not reported in melons and male sterility is commercially not being used to develop the hybrids.
Sex expression in melon can be temporarily altered through application of growth regulators that mimic the genes responsible for inducing or supressing stamen production (Pitrat, 2016) [1]. It also gets affected by environmental factors like light hours, temperature and moisture level. Ethylene application hinders maleness whereas by spray with silver nitrate, results in stamen production in female flowers. Hand pollination to produce hybrids is easier in melon as the flowers are relatively bigger and more number of seeds can be produced but hermaphrodite

flowers need to be emasculated on andromonoecious plants. It is reported that gene ‘a’ has pleiotropic effect (one gene controlling more than one character) on fruit shape. Pistillated flowers (without stamen) tend to produce elongated fruits (Pitrat, 2016) [1]. Fruit shape is one of the important qualitative traits to attract the consumers. Understanding the inheritance of sex expression helps in deciding the breeding method (Grumet and Taft, 2012) [11] and to handle the segregating material. This paper reports on the inheritance of sex expression and fruit shape in the crosses involving monoecious (landraces and wild type) and andromonoecious (cultivated and improved) parents belonging to various botanical types and possessing varied fruit shapes. The landraces and wild genotypes used in the present study are un-explored for breeding as well as to study the inheritance of any traits in melon. Studying the inheritance of sex expression and fruit shape in these un-explored materials will be useful in melon improvement.

Materials and Methods

The melons belonging to nine botanical groups were included in the study. The botanical group and features of melon accessions are given in Table 1.

Table 1: The description of melon accessions of various botanical groups included in the study.

Accessions	Common name	Botanical group	Sex expression	Fruit shape	Status of the genotype
Kashi Madhu		*chandalak*	Andromonoecious	Oblate	Cultivated varieties
IC231367		*cantalopensis*	Andromonoecious	Oblate	Cultivated varieties
IC231371		*indicus*	Andromonoecious	Ovate	Cultivated varieties
IC632181	Sidoota	*reticulatus*	Andromonoecious	Round	Cultivated varieties
Arka sheetal	Longmelon	*flexousus*	Monoecious	Cylindrical	Cultivated varieties
IC632170	Snapmelon	*momordica*	Monoecious	Oval	Landrace
IC632176	Yeresavathe	*unknown*	Monoecious	Cylindrical	Landrace
IC632177	Wildmelon	*acidulous*	Monoecious	Oval	Landrace
IC632171	Budamekaayi	*kachri*	Monoecious	Oval	Wild

Development and evaluation of hybrids: Kashi Madhu (*chandalak*), IC321367 (*cantalopensis*) and IC321371 (*indicus*) were used as seed parents and IC632181 (*reticulatus*), Arka sheetal (*flexousus*), IC632170 (*momordica*), IC632176, IC632177 (*acidulous*) and IC632171 (*kachri*) were used as pollen parents. The parents of different botanical groups used for crossing programme were stable and were not segregating for sex expression as well as fruit shape (Chaitra, 2019) [8]. Crosses were made under polyhouse condition to prevent pollen contamination by insect pollinators. Since all the three seed parents were andromonoecious, emasculation was done in the previous day evening. Eighteen F_1 hybrids were produced by hand emasculation and pollination. The F_1 and parent seedlings were raised in portray and planted to beds after 20 days. Spacing 45×60 cm between plants and lines, respectively was maintained. Randomized complete block design was followed with three replications for evaluation of hybrids during *kharif* of 2020. Based on the presence of male and female, or male and hermaphrodite flower, respective plants were categorized as monoecious or andromonoecious. Fruit shape in the longitudinal section was observed visually and fruits were categorized into ovate, oval, elongated globe, round, oblate and cylindrical shapes based on Protection of Plant Varieties and Farmers' Rights Authority **(**PPV and FRA) guidelines for melon (Choudhary *et al.*, 2019) [9].

Production of F_2 and backcrosses generations for selected cross combinations

Among 18 combinations of hybrid, Kashi Madhu X Snapmelon **(**IC632170) and IC231367 X Arka sheetal (Longmelon) hybrids (F_1) were selfed as well as backcrossed with their parents to obtain F_2 and backcross populations (BC_1 (P_1) and BC_1 (P_2) lines), respectively. BC_1 (P_1) is backcross of Kashi Madhu X IC632170 with Kashi Madhu and BC_1 (P_2) was backcross of F_1 with IC632170 for cross combination 1. Cross combination 2 is backcross of IC231367 X Arka sheetal with IC231367 for BC_1 (P_1) and BC_1 (P_2) was backcross of F_1 with Arka sheetal.

Evaluation of parents, hybrids, F_2 and back crosses

The two parents and their F_1, F_2, BC_1 (P_1) and BC_1 (P_2) lines of each combination of crosses were cultivated under the polyhouse condition at the College of Horticulture, University of Horticultural Sciences, Bagalkot campus, Bengaluru during the winter season of 2020. Three replications of parents and F_1 and un-replicated F_2 and back crosses were evaluated for sex expression and fruit shape. In the segregating plants of F_2 and back crosses, observations were recorded on individual plant basis. Sex expression and fruit shape were visually observed at flowering and fruit maturity time, respectively.
Chi square test was performed according to Gomez and Gomez, 1984.

$$\chi 2 = \frac{\sum(O- E)^2}{E}$$

O = Observed value; E = Expected value.

Results

All the three seed parents Kashi Madhu, IC321367 and IC321371, one of the pollen parent IC632181, and their hybrids were andromonoecious in sex expression (Table 2). Other pollen parents (monoecious) IC632170, IC632177, IC632171, Arka Sheetal and IC632176 and their hybrids with all three female parents (andromonoecious) were monoecious indicating the dominance of monoecious over andromonoecious.
Fruit shape expressed variation among the parents and hybrids. Kashi Madhu and IC321367 were oblate and their hybrids with the oval shaped fruited pollen parents (IC632170, IC632171 and IC632177) were in elongated globe shape. IC321371 was the only parent with ovate shape and its hybrids with oval shaped (IC632171 and IC632177) fruited pollen parents were also in ovate shape. IC632176 and Arka Sheetal were cylindrical in shape and their hybrids with all three female parents were in intermediate of cylindrical and oval shape. Crosses between genotype with round fruit (IC632181) and its hybrids with oblate shaped fruit parents resulted in round fruits (Table 2).

Table 2: Variation in parents and inter-botanical hybrids for sex expression and fruit shape

Sex expression	
Classes	**Parents and inter-botanical hybrids**
Andromonoecious	Parents - Kashi Madhu, IC321367, IC321371 and IC632181 Crosses - Kashi Madhu x IC632181, IC321367 x IC632181 and IC321371 x IC632181
Monoecious	Parents -IC632170, IC632177, IC632171, Arka Sheetal and IC632176 Crosses - Kashi Madhu x IC632170, Kashi Madhu x IC632177, Kashi Madhu x IC632176, Kashi Madhu x IC632171, Kashi Madhu x Arka Sheetal, IC321367 x IC632170, IC321367x IC632177, IC321367 x IC632176, IC321367x IC632171, IC321367 x Arka Sheetal, IC321371 x IC632170, IC321371 x IC632177, IC321371 x IC632176, IC32137 x IC632171 and IC321371 x Arka Sheetal

Fruit shape in longitudinal section	
Classes	**Parents and inter-botanical hybrids**
Oblate	Kashi Madhu, IC321367
Oval	Parents - IC632170, IC632171 and IC632177
Elongated globe	Crosses -Kashi Madhu x IC632170, Kashi Madhu x IC632171, Kashi Madhu x IC632177, IC321367 x IC632170, IC321367 x IC632177, IC321367 x IC632171 and IC321371 x IC632170
Round	Parents - IC632181 Crosses - IC321367 x IC632181 and Kashi Madhu x IC632181
Ovate	Parents - IC321371 Crosses - IC321371 x IC632177, IC321371 x IC632171
Cylindrical	Parents - IC632176 and Arka Sheetal
Intermediate of cylindrical and oval	IC321367 x IC632176, IC321371 x IC632176, Kashi Madhu x IC632176, Kashi Madhu x Arka Sheetal, IC321371 x Arka Sheetal, IC321367 x Arka Sheetal,

In F_2 and back cross generations of cross IC321367 x Arka Sheetal / Longmelon, the male parent, F_1, 115 F2s, 39 BC1 (P1) plants and all the 98 plants of BC1 (P2) were monoeciousin sex expression. Parent IC321367, 26 F2s, 30 BC1 (P1) plants were andromonoecious. None of the BC1 (P2) were andromonoecious. The calculated chi square values (χ^2 = 3.236 and 1.173; P = >.05) were found to be non- significant in F_2 and BC_1 (P_1), respectively for sex expression indicating the monogenic control (Table 3). Similar results were obtained for the cross Kashi Madhu x IC632170 (Snapmelon). 46 F_2s and 27 BC_1 (P_1) plants were andromonoecious like Kashi Madhu whereas 155 F_2s, 23 BC_1 (P_1) plants and all 87 BC_1 (P_2) were monoecious like pollen parent IC632170. The chi square values (χ^2 = 0.479 and 0.320; P = >.05) were non- significant in F_2 and BC_1 (P_1), respectively (Table 3).

Table 3: Chi square analysis of F_2 and back cross populations derived from the inter-botanical crosses for sex expression.

Parent/ population	Categories	O	E	Ratio	χ^2	P	Gene action
IC321367	Andromonoecious	all					Monogenic complete dominance
Arka Sheetal	Monoecious	all					
F_1	Monoecious	all					
F_2	Monoecious	115	105.75	3.1	3.236	0.072	
	Andromonoecious	26	35.25				
BC_1 (P_1)	Monoecious	39	34.50	1.1	1.173	0.278	
	Andromonoecious	30	34.50				
BC_1 (P_2)	Monoecious	98		1.0			
	Andromonoecious	0					
Kashi Madhu	Andromonoecious	all					Monogenic, complete dominance
IC632170	Monoecious	all					
F_1	Monoecious	all					
F_2	Monoecious	155	150.75	3:1	0.479	0.488	
	Andromonoecious	46	50.25				
BC_1 (P_1)	Monoecious	23	25.00	1:1	0.320	0.571	
	Andromonoecious	27	25.00				
BC_1 (P_2)	Monoecious	87		1:0			
	Andromonoecious	0					

In the cross combination of oblate shaped IC321367 X cylindrical shaped Arka Sheetal / Longmelon, F_2 segregated into three classes (Cylindrical-36, Intermediate-74 and Oblate-31) in the ratio of 1:2:1 with the non- significant values for calculated chi square (χ^2 = 0.879, P = >.05). Oblate and intermediate shaped were observed in BC_1 (P_1), the backcross with oblate shaped fruit parent IC321367. The chi square value was non-significant (χ^2 =0.710, P = >.05). Cylindrical (41) and intermediate shaped (57) fruit plants were observed in 1:1 ratio with a non-significant chi square value of 2.612 for the back cross with cylindrical fruited parent Arka Sheetal (Table 4).

Table 4: Chi square analysis of F_2 and back cross populations derived from the inter-botanical crosses for fruit shape.

Parent/ population	Categories	O	E	Ratio	χ^2	P	Gene action
IC321367	Oblate	all					Monogenic, Incomplete dominance
Long melon	cylindrical	all					
F_1	Intermediate	all					
F_2	Cylindrical	36	35.25	1:2:1	0.879	0.703	
	Intermediate	74	70.50				
BC_1 (P_1)	Oblate	31	35.25	1:1	0.710	0.399	
	Oblate	31	34.50				
BC_1 (P_2)	Intermediate	38	34.50	1:1	2.612	0.106	
	Cylindrical	41	49				
	Intermediate	57	49				
Kashi Madhu	Oblate	all					Monogenic, Incomplete dominance
IC632170	Oval	all					
F_1	Elongated globe	all					
F_2	Oblate	42	50.25	1:2:1	1.925	0.381	
	Elongated globe	108	100.50				
	Oval	51	50.25				
BC_1 (P_1)	Oblate	26	25.00	1:1	0.080	0.777	
	Elongated globe	24	25.00				
BC_1 (P_2)	Elongated globe	40	43.50	1:1	0.563	0.452	
	Oval	47	43.50				

Among the segregating lines of another cross Kashi Madhu X IC632170 also the chi square values were non-significant (χ^2 =1.925, 0.080 and 0.563 P = >.05) for F_2 (oblate-42, elongated globe-108, oval -51), BC_1 (P_1) population (oblate-26, elongated globe-24) and BC_1 (P_2) population (elongated globe-40, oval -47), respectively. The ratio 1:2:1 for F_2, 1:1 for both the back crosses indicated the incomplete dominance for fruit shape.

Discussion

Botanical types in melon express different sex forms but andromonoecious (*Cantalupensis, Inodorus, Ibericus, Cassaba, Ameri Chandalak, Dudaim, Indicus, Chinensis, Makuwa Conomon, Tibish*) and monoecious (*Chate, Flexuosus Momordica, Acidulus, Chito, Agrestis, Kachri*) are more prevalent (Pitrat, 2016) [1]. In the present study, all landraces and a wild type melon used as pollen parents for making crosses were monoecious and either cylindrical or oval in shape. Their hybrids with andromonoecious sex expressing parents were also found to be monoecious. Only when both the parents were andromonoecious, the hybrids were andromonoecious. Wild melons are monoecious and majority of the cultivated melons are either andromonoecious or hermaphrodite (Pitrat, 2016) [1] with some exceptions where wild melon are found to be andromonoecious (Zhang *et al*., 2019; Nashiki *et al*., 2023) [13, 14]. We have noticed in our previous studies (Chaitra, 2019; Manchali *et al*., 2021) [8, 2] that most of the landraces and wild type are monoecious in their sex expression and usually appear in oval or cylindrical shape but a Japanese weedy melon accession (UT1) was found to be hermaphrodite even it had *GGMM* genotype responsible for a monoecious line (Nashiki *et al*., 2023) [13].

In the present study, monoecious was found to be dominant over andromonoecious as all the hybrids derived from crossing monoecious and andromonoecious parents were monoecious in nature. This was supported by the non-significant chi square values obtained for F_2 and backcrosses. A ratio of 3:1, 1:1 and 1:0 (Monoecious to andromonoecious) were observed for F_2, BC_1 (P_1) and BC_1 (P_2), respectively for sex expression. The results of this study on sex expression were similar to those reported by Singh *et al*. (2011) [15].

Two genes *a* (andromonoecious gene that is responsible for production of stamens in female flowers) and *g* (gynoecious gene that determine transition of monoecious plants to gynoecious plants) are reported to be mainly involved in the genetic control of sex expression in melon (Pitrat, 2016) [1]. The earlier experiments in melon also reports two gene control of sex expression (Poole and Grienball, 1939) [3] but some studies have shown interaction of three or more genes (locus *m* in addition to *a* and *g*) responsible for various sex forms in melon (Kenigsbuch and Cohen, 1990; Boualem *et al*., 2008; Nashiki *et al*., 2023) [6, 16, 14]. Experiments on the inheritance of flower type in melon indicate dominance of monoecism over andromonecism (Singh *et al*., 2011; Kavya and Manchali, 2019) [15, 17]. Various genes responsible for sex determination in different melon accessions are mapped to chromosomes (Kishor *et al*. 2021; Wang *et al*. 2022; Zhang *et al*., 2022; Nashiki *et al*., 2023) [18, 19, 14] but the discovery for new genes under different background of melon is a continues process.

Sex determining gene 'a' is reported to have pleiotropic effect on fruit shape. Female flowers devoid of stamen tend to bear elongated fruits compared to pistillated flowers with stamen, which are round in shape (Noguera *et al*., 2005; Sakata *et al*., 2013; Pitrat, 2016) [21, 22, 1]. In the present study, all the oval and cylindrical shaped fruits parents were monoecious and andromonoecious parents were round or oblate shaped except IC321371 that had ovate shaped fruits. Setiawan *et al*. (2025) [23] also noticed F_1 progenies with andromonoecious phenotypes producing round fruit shapes and those with monoecious phenotypes producing oval fruit shapes.

The fruit shape in hybrids between oblate shaped fruit parent and oval fruited one were in elongated globe shape and their segregating generation F_2 and back crosses indicated the incomplete dominance for fruit shape. A ratio of 1:2:1, 1:1 and 1:1 was observed for F_2s, BC_1 (P_1) and BC_1 (P_2). In the combination of parents with oblate and cylindrical fruits, the F_1 was intermediate between the parents for fruit shape. This combination also indicated the monogeneic incomplete dominance for fruit shape. Hybrids of genotypes with round fruit (IC632181) and oblate shaped fruited parents (Kashi Madhu and IC63367) resulted in round fruits indicated the dominance of round over oblate shape.

Knowledge of sex expression in melons is very essential for planning breeding strategies. Its association with fruit shape also makes it necessary to understand the inheritance of sex expression as well as fruit shape in the background of various melon types including the wild type. In this regard, the present research furnishes some useful information regarding the inheritance of both these traits in the cross combination of landraces, wild and cultivated melon genotypes.

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Ethical Statements
Nil.

Conflict of Interest
Nil.

References
1. Pitrat M. Melon genetic resources: phenotypic diversity and horticultural taxonomy. In: Grumet R, Katzir N, Garcia-Mas J, editors. Genetics and Genomics of Cucurbitaceae, Plant Genetics and Genomics: Crops and Models. New York: Springer International Publishing; 2016. p. 25-60.
2. Manchali S, Mamatha S, Umesha K, Lingaiah HB, Mohankumar S. Genetic variation in melon (*Cucumis melo* L.) landraces and wild relatives of Karnataka state of southern India. Plant Genetic Resources. 2021;19(5):419-427.
3. Poole CF, Grimball PC. Inheritance of sex forms in *Cucumis melo* L. Journal of Heredity. 1939;30:21-25.
4. Pitrat M. Melon (*Cucumis melo* L.). In: Prohens J, Nuez F, editors. Handbook of Crop Breeding, Vol. I: Vegetable. New York: Springer; 2008. p. 283-315.
5. Kubicki B. Sex determination in muskmelon (*Cucumis melo* L.). Genetica Polonica. 1969;10:145-146.
6. Kenigsbuch D, Cohen Y. The inheritance of gynoecy in muskmelon. Genome. 1990;33:317-320.
7. Munshi AD, Alvarez JM. Hybrid melon development. Journal of New Seeds. 2005;6:321-324.
8. Chaitra S. Studies on genetic diversity and crossing ability among inter-botanical groups of melon (*Cucumis melo* L.) [M.Sc. thesis]. Bagalkot (India): University of Horticultural Sciences; 2019.
9. Choudhary BR, Singh D, Saroj PL. Development and characterization of intraspecific hybrids derived from *Cucumis melo* L. Bangladesh Journal of Botany. 2019;48(2):359-366.
10. Rashmi S. Studies on genetic basis of sex expression, fruit and seed traits in melon (*Cucumis melo* L.) [PhD thesis]. Bagalkot (India): University of Horticultural Sciences; 2023.
11. Grumet R, Taft J. Sex expression in cucurbits. In: Wang YH, Behera TK, Kole C, editors. Genetics, Genomics and Breeding of Cucurbits. Taylor & Francis Group; 2012. p. 351-375.
12. Gomez KA, Gomez AA. Statistical procedure for agricultural research. 3rd ed. New York: John Wiley & Sons; 1984. p. 680.
13. Zhang H, Li X, Yu H, Zhang Y, Li M, Wang H, *et al*. A high-quality melon genome assembly provides insights into genetic basis of fruit trait improvement. iScience. 2019;22:16-27.
14. Nashiki A, Matsuo H, Takano K, Fitriyah F, Isobe S, Shirasawa K, *et al*. Identification of novel sex determination loci in Japanese weedy melon. Theoretical and Applied Genetics. 2023;136(6):136.
15. Singh S, Pandey S, Raghuwanshi R, Singh PK, Jha A, Singh M. Inheritance of sex expression and fruit bursting in melons. Vegetable Science. 2011;38(2):225-227.
16. Boualem A, Fergany M, Fernandez R, Troadec C, Martin A, Morin H, *et al*. A conserved mutation in an ethylene biosynthesis enzyme leads to andromonoecy in melons. Science. 2008;321:836-838.
17. Kavya KR, Manchali S. Inheritance pattern of F_2 population of melon (*Cucumis melo* L.) for various fruit traits and ovary characters. International Journal of Current Microbiology and Applied Sciences. 2019;8(11):2091-2096.
18. Kishor DS, Noh Y, Song WH, Lee GP, Park Y, Jung Y, *et al*. SNP marker assay and candidate gene identification for sex expression via genotyping-by-sequencing-based genome-wide association analyses in Oriental melon (*Cucumis melo* L. var. *makuwa*). Scientia Horticulturae. 2021;276:109711.
19. Wang Z, Zhang S, Yang Y, Li Z, Li H, Yu R, *et al*. Novel bisexual flower control gene regulates sex differentiation in melon (*Cucumis melo* L.). Journal of Agricultural and Food Chemistry. 2022;70:15401-15414.
20. Zhang S, Tan F, Chung C, Slavkovic F, Devani RS, Trodec C, *et al*. The control of carpel determinacy pathway leads to sex determination in cucurbits. Science. 2022;378:543-549.
21. Noguera FJ, Capel J, Alvarez JI, Lozano R. Development and mapping of a codominant SCAR marker linked to the andromonoecious gene of melon. Theoretical and Applied Genetics. 2005;110(4):714-720.
22. Sakata Y, Fukino N, Ohara T, Sugiyama M, Yoshioka Y. Effect of monoecious trait on fruit shape and total soluble solid contents of melon. Horticultural Research. 2013;12(1):15-22.
23. Setiawan AB, Auliauzzakia I, Purwantoro A. Genetic variability in F_2 melon (*Cucumis melo* L.) population from double cross of sex-distinct parent lines. Caraka Tani: Journal of Sustainable Agriculture. 2025;40(2):281-294.