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## Multivariate analysis in sweet potato (*Ipomoea batatas* (L.) Lam.)

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### Abstract

Sweet potato (*Ipomoea batatas* (L.) Lam.), a hexaploid crop belonging to the family *Convolvulaceae*, is the sixth most important food crop worldwide, valued for its highly nutritious storage roots and leaves. In the present study, twenty sweet potato genotypes were evaluated in a randomized block design with three replications during the *kharif* season 2025. Nine qualitative traits viz., growth habit, ground covering capacity, insect resistance of shoot, vine hairs, predominant vine color, leaf shape, leaf hairs, and colour of adaxial and abaxial leaf surfaces were recorded using IBPGR descriptors and were subjected to a Multiple Correspondence Analysis (MCA). The results revealed considerable phenotypic diversity among the genotypes. Growth habit ranged from semi-compact (55%) to spreading (35%) and very spreading (10%), with no compact types among all were observed. Regarding ground coverage, 50% of genotypes covered more than 50% of the ground area, while the remaining 50% showed moderate or less than 20% coverage. Only 20% of genotypes were free of insect damage, while 80% showed sparse pest infestation, with the pest-free genotypes identified as potential parental lines for resistance breeding. Vine pubescence was more prevalent (55%) than leaf pubescence (10%), underlining its role in climate resilience and host plant resistance. Leaf shape varied from hastate (45%) and lobed (35%) to cordate (15%) and almost divided (5%), with the genotype IB20 being the only one to exhibit an almost divided leaf shape. Predominant vine colour was green with purple spots in 65% of genotypes, while genotypes IB12 and IB13 exhibited unique purple pigmentation associated with anthocyanin accumulation, conferring both ornamental and nutraceutical value. MCA-based cluster analysis grouped the twenty genotypes into three distinct clusters, with cluster 3 being the largest with 16 genotypes. Clusters 1 and 2 each comprised of two genotypes each. The diverse morphological profiles observed suggested the multiple end-use potentials including mono-cropping, intercropping, container cultivation, ornamental landscaping, and resistance breeding, highlighting the significance of qualitative characterization in harnessing sweet potato germplasm diversity.

**Keywords:** *Ipomoea batatas*, qualitative traits, morphological characterization, IBPGR descriptors, multiple correspondence analysis, germplasm diversity

### Introduction

Sweet potato is the vital crop which is extremely nutritious plant. It belongs to the family *Convolvulaceae* <sup>[1]</sup>. The mode of pollination is cross pollinated and exhibits heterozygosity nature. The ploidy nature of sweet potato is hexaploidy ( $2n = 6x = 90$ ). China ranks top in the global production contributing 50% of the yield, globally <sup>[2]</sup>. It is cross-pollinated due to its self-incompatibility <sup>[3]</sup>. Sweet potato is the sixth most important crop worldwide. The crop has grown across the world around 110 countries. In India, the area under sweet potato cultivation is 0.13 Mha with the production of 1.47 Mtonnes <sup>[4]</sup>. It is the versatile crop both the tuber and the leaves are highly nutritious. The storage roots are high in protein, dietary fiber, micronutrients, vitamins, and bioactive components such as  $\beta$ -carotene and phenylpropanoids <sup>[5]</sup>.

Domesticated sweet potato varieties vary in certain phenotypic and genotypic characteristics, they are rich in sugars, starch, vitamins, minerals, bioactive proteins and lipids, carotenoids, polyphenols, ascorbic acid, alkaloids, coumarins, and saponins. These phytochemicals, either separately or in combination, aid in the prevention of numerous diseases, such as cardiovascular conditions and some forms of cancer <sup>[6]</sup>. Sweet potato was first domesticated in Neotropical America, and due to the migration of human, the distribution of sweet potato

plant across the world. Sweet potato germplasm has identified mainly by phenotypic characterization. Molecular characterization used to find the genetic diversity of the crop using genetic markers such as SSR, SNP, ISSR, AFLP and RFLP [7].

## Materials and Methods

In this study twenty genotypes were raised in randomized block design with three replications in *kharif* season 2025. These genotypes were analyzed for nine qualitative such as traits growth habit, ground covering capacity, insect resistance of shoot, vine hairs, predominant vine color, leaf shape, leaf hairs, color of adaxial leaf surface and color of the abaxial leaf surface. The traits were recorded by using IBPGR descriptors. The data of the nine qualitative traits were subjected to a Multiple Correspondence analysis in R version 4.5.3. The list of genotypes utilized in the study are listed in (Table 1).

## Results and Discussion

### Qualitative analyses

The twenty genotypes were analyzed for nine qualitative traits. Among all seven genotypes showed spreading and two showed very spreading nature. These growth types with spreading require more spacing and that is suited for bed planting due to its thick veins and maximum group coverage. There was no compact habit in any genotypes. Ten of the genotypes had semi compact growth habit. And this is used for pot cultivation. The spreading types could be suitably recommended for mono-cropping or sole cropping. Since these types require wide spacing for spreading their veins and for ground coverage, they need to be raised in wider spacing conditions in field [8]. And the semi-compact genotypes could be recommended suitably for intercropping methods with legumes. Owing to, the compact nature of these genotypes, it prevents the interspecific competitions and allows companion crops sufficient light [9].

Moreover, ten genotypes showed a capability to cover the ground more than 50%, it spreads their lateral vines into nearby areas. Five genotypes were observed with 20% coverage, five genotypes showed a moderate coverage (20% to 50%). These genotypes could also be recommended for multiple and mixed cropping systems [9].

Another trait was resistance to pest attack, only four genotypes were completely resistant pest. And other sixteen showed just mild damage from pest. Thus, the ones with the lowest pest infestations could be suitably recommended to possess a higher marketability and could be further evaluated for quality traits in breeding programs [10].

Among all the genotypes, vine hairiness was more common in vine than in leaves. Out of twenty, only two genotypes showed hairy leaves and seven genotypes had hairy veins. Pubescence is a key trait for climate resilience and host plant resistance in sweet potato [11].

By analyzing leaf shapes, seven genotype showed lobed leaf, three had cordate leaves, nine had hastate leaf shapes and only one genotype (IB20) exhibited almost divided leaf shape. These leaf shape was suitable for pot culture [12].

The genotype IB 12 showed purple leaf color on both the sides which made that genotype unique. And the genotype IB 13 showed variegated in their leaves which can be used for decorative arrangements. This anthocyanin are free radicle scavengers, reducing oxidative stress and chronic

diseases such as diabetes, cancer, and cardiovascular diseases. Also it regulates glucose metabolisms [13].

### Frequency distribution

Among all the genotypes, 55% of genotypes exhibited semi compact growth habit, 35% showed spreading type and 10% very spreading growth habit. Semi-compact growth habit is used for container cultivated for tuber production [14]. Spreading and very spreading growth habit has low weed emergence on the field [15].

Then, half of the genotypes were covered almost on the ground, then 25% was moderately covered and 25% showed less than 20% of ground coverage. The complete ground coverage reduces the soil erosion as well performing for weed control [16]. The less ground coverage genotypes are suitable for mono-cropping where it gets high yield [17].

Only four genotypes (20%) were free of insect damage and other 80% of genotypes were affected by pest sparsely. The genotypes which were insect free, they can be used as parental lines to develop pest resistant varieties [18].

Vine hair was the most common traits, 55% of genotypes had vein hairs but 45% of genotypes had no vine hairs. But in leaf 90% of genotypes showed absence of hairs and 10% of genotypes showed presence of hairs.

The predominant vines showed diverse colors, 10% of genotypes had green vines, 65% of genotypes showed green with purple spots, 20% of vines had mostly or totally purple and only 5% of genotypes showed totally dark purple. Purple pigmentation act as a defense mechanism in climbing plants. Because, it is associated with higher phenolic compounds which had anti-feeding effects [17].

Followed by leaf shape, only 5% of genotypes showed almost divided shape, 15% of genotypes showed cordate shape of leaves, 45% of genotypes showed hastate shape of leaves, and 35% of genotypes showed lobed type of shape.

At last, 55% of total genotypes showed green color in their adaxial leaf surface, 30% of genotypes showed green with purple border, 5% of green with veins and 10% of the genotypes showed purple surfaces. Meanwhile, 35% of genotypes showed green color in abaxial leaf surface, 30% of genotypes showed purple at the vein base, 20% of genotypes were main vein partially or totally purple, 5% of genotypes showed all veins partially or totally purple and 10% of genotypes ad purple surfaces and veins. The anthocyanin pigment in leaves protect tissue under stress and improve survival in exposed climbing habitats [18].

### Cluster Analysis

In this clustering by MCA (Multiple Correspondence Analysis), a high variability among twenty genotypes were observed. These genotypes were divided into three clusters. Among the three, cluster 3 was the largest cluster with sixteen genotypes. And other two clusters had two genotypes respectively.

Cluster 3 was grouped with the genotypes according to their moderately ground covering capacity, leaf shape and predominant vine color. It had hastate, cordate and lobed leaf shape. These genotypes also had green with purple spots veins. These kinds of leaves are common in improving light absorbing capacity in verticals systems. Also it has better light penetration in canopy coverage [19].

Cluster 1 had two genotypes, G12 and G13. They had hairiness traits with purple pigmentation. Trichomes act as the mechanical and chemical barriers against pest from

feeding the plants <sup>[20]</sup>. And the cluster 2 also had two genotypes, G1 and G20. The genotypes G20 showed almost divided shape of leaf which is unique and it was also affected by pest but G1 was free of insect damages. It can be used as a parental line for resistant line development <sup>[21]</sup>.

The divided leaf shape could be a major reason for its exposure to pest damage and useful for studying host-pest interaction in future <sup>[22]</sup>.

### Tables and figures

**Table 1:** List of germplasm

| S. No | Name of the accession | Codes |
|-------|-----------------------|-------|
| 1     | IB 1                  | G1    |
| 2     | IB 2                  | G2    |
| 3     | IB 3                  | G3    |
| 4     | IB 4                  | G4    |
| 5     | IB 5                  | G5    |
| 6     | IB 6                  | G6    |
| 7     | IB 7                  | G7    |
| 8     | IB 8                  | G8    |
| 9     | IB 9                  | G9    |
| 10    | IB 10                 | G10   |
| 11    | IB 11                 | G11   |
| 12    | IB 12                 | G12   |
| 13    | IB 13                 | G13   |
| 14    | IB 14                 | G14   |
| 15    | IB 15                 | G15   |
| 16    | IB 16                 | G16   |
| 17    | IB 17                 | G17   |
| 18    | IB 18                 | G18   |
| 19    | IB 19                 | G19   |
| 20    | IB 20                 | G20   |

**Table 2:** Descriptions of Qualitative Data

| Sl. No. | Qualitative Trait                 | Scores          | Description                                                                                                          |
|---------|-----------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------|
| 1.      | Growth Habit                      | 1               | Compact                                                                                                              |
|         |                                   | 2               | Semi-Compact                                                                                                         |
|         |                                   | 3               | Spreading                                                                                                            |
|         |                                   | 4               | Very Spreading                                                                                                       |
| 2.      | Ground Covering Capacity          | 1               | Covered ( $\leq 100\%$ e $> 50\%$ covered)                                                                           |
|         |                                   | 2               | moderately covered ( $\leq 50\%$ e $> 20\%$ covered)                                                                 |
|         |                                   | 3               | visible ( $\leq 20\%$ covered)                                                                                       |
| 3.      | Insect resistance of shoot        | 1               | Free of insect damage                                                                                                |
|         |                                   | 2               | little damage                                                                                                        |
|         |                                   | 3               | damage harmful to landscaping (less 50% of the plant with holes or chlorosis)                                        |
|         |                                   | 4               | damage that makes it practically unusable for landscaping ( $> 50\%$ of the plant with holes, chlorosis or necrosis) |
| 4.      | Vine hairs                        | 5               | damages that makes it unacceptable for landscaping purposes ( $> 80\%$ of plants with holes, Chlorosis or necrosis)  |
|         |                                   | 0               | absence of vine hair                                                                                                 |
| 5.      | Predominant vine color            | 1               | presence of vine hair                                                                                                |
|         |                                   | 2               | green                                                                                                                |
|         |                                   | 3               | green with few purple spots                                                                                          |
|         |                                   | 4               | mostly or totally purple                                                                                             |
|         |                                   | 5               | totally dark purple                                                                                                  |
| 6.      | Leaf shape                        | gray            |                                                                                                                      |
|         |                                   | 1               | Almost divided                                                                                                       |
|         |                                   | 2               | cordate                                                                                                              |
|         |                                   | 3               | triangular                                                                                                           |
|         |                                   | 4               | hastate                                                                                                              |
| 7.      | Leaf hairs                        | 5               | lobed                                                                                                                |
|         |                                   | 0               | absence of hairs                                                                                                     |
| 8.      | Color of the adaxial leaf surface | 1               | presence of hairs                                                                                                    |
|         |                                   | 2               | Green                                                                                                                |
|         |                                   | 3               | green with purple border                                                                                             |
|         |                                   | 4               | green with veins                                                                                                     |
|         |                                   | 5               | green with purple at the bottom                                                                                      |
| 9.      | Color of the abaxial leaf surface | purple surfaces |                                                                                                                      |
|         |                                   | 1               | green                                                                                                                |
|         |                                   | 2               | purple at the vein base                                                                                              |
|         |                                   | 3               | main vein partially or totally purple                                                                                |
|         |                                   | 4               | all veins partially or totally purple                                                                                |
|         |                                   | 5               | purple surface and veins                                                                                             |

Table 3: Scoring details of twenty genotypes

| GEN | GH | GCC | IR | VH | PVC | LS | LH | CULS | CLLS |
|-----|----|-----|----|----|-----|----|----|------|------|
| G1  | 2  | 2   | 1  | 1  | 1   | 2  | 0  | 2    | 2    |
| G2  | 2  | 3   | 2  | 1  | 2   | 5  | 0  | 1    | 1    |
| G3  | 3  | 2   | 2  | 0  | 2   | 2  | 0  | 1    | 1    |
| G4  | 3  | 1   | 2  | 0  | 3   | 5  | 0  | 2    | 4    |
| G5  | 3  | 2   | 2  | 0  | 2   | 4  | 0  | 3    | 3    |
| G6  | 2  | 3   | 2  | 0  | 2   | 4  | 0  | 1    | 3    |
| G7  | 3  | 1   | 1  | 0  | 2   | 5  | 0  | 2    | 1    |
| G8  | 2  | 3   | 2  | 0  | 2   | 4  | 0  | 2    | 2    |
| G9  | 4  | 1   | 2  | 0  | 2   | 4  | 0  | 2    | 2    |
| G10 | 2  | 3   | 1  | 0  | 3   | 4  | 0  | 1    | 1    |
| G11 | 2  | 1   | 2  | 1  | 2   | 5  | 0  | 1    | 1    |
| G12 | 2  | 1   | 2  | 1  | 3   | 5  | 1  | 5    | 5    |
| G13 | 3  | 1   | 2  | 1  | 4   | 2  | 1  | 5    | 5    |
| G14 | 2  | 1   | 2  | 1  | 2   | 4  | 0  | 1    | 2    |
| G15 | 2  | 3   | 1  | 0  | 2   | 4  | 0  | 2    | 3    |
| G16 | 2  | 1   | 2  | 0  | 2   | 5  | 0  | 1    | 1    |
| G17 | 2  | 2   | 2  | 0  | 3   | 5  | 0  | 1    | 1    |
| G18 | 4  | 1   | 2  | 1  | 2   | 4  | 0  | 1    | 3    |
| G19 | 3  | 2   | 2  | 1  | 2   | 4  | 0  | 1    | 2    |
| G20 | 3  | 1   | 2  | 1  | 1   | 1  | 0  | 1    | 2    |

GEN-Genotypes, GH-Growth habit, GCC-Ground covering capacity, IR-Insect resistance, VH-Vine hairs, PVC-Predominant vine color, LS-Leaf shape, LH-Leaf hairs, CULS-Color of the adaxial leaf surface, CLLS-Color of the abaxial leaf surface

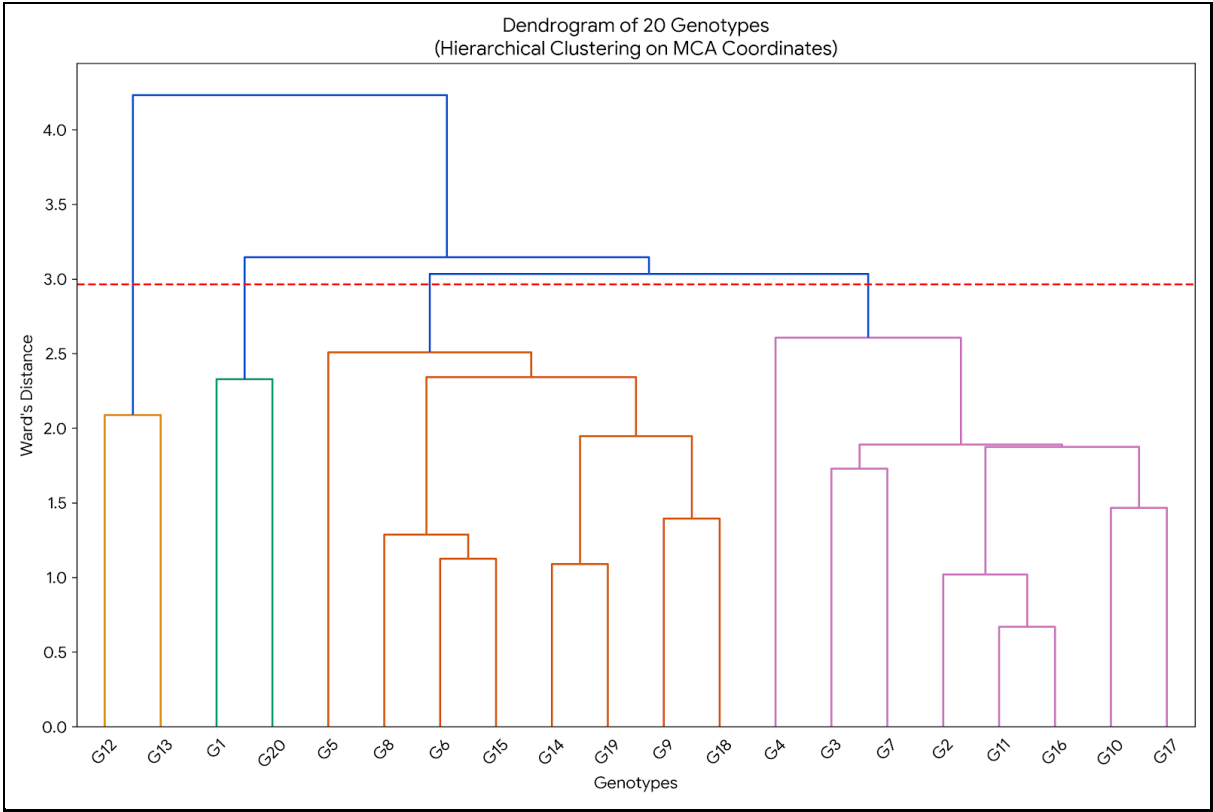


Fig 1: Dendrogram of 20 genotypes

References

1. Islam S. Sweetpotatoes (*Ipomoea batatas* (L.) Lam): the super food of the next century? An intensive review on their potential as a sustainable and versatile food source for future generations. *CyTA J Food*. 2024;22(1):2397553. doi:10.1080/19476337.2024.2397553.

2. Maqsood S, Basher NS, Arshad MT, Ikram A, Kalman DS, Hossain MS, *et al*. Anthocyanins from sweet potatoes (*Ipomoea batatas*): bioavailability, mechanisms of action, and therapeutic potential in diabetes and metabolic disorders. *Food Sci Nutr*. 2025;13(9):e70895. doi:10.1002/fsn3.70895.

3. Amritha MS, Dhanya OG, Nair AGH, Vidya P, Muthusamy SK, Mohan C. Genetic diversity studies between *Ipomoea* wild species and cultivated sweet potato (*Ipomoea batatas* (L.) Lam.) using SSR markers. *S Afr J Bot*. 2024;169:452-463. doi:10.1016/j.sajb.2024.04.043.

4. Drapal M, Rossel G, Heider B, Fraser PD. Metabolic diversity in sweet potato (*Ipomoea batatas* Lam.) leaves and storage roots. *Hortic Res*. 2019;6(1):2-10. doi:10.1038/s41438-018-0075-5.

5. Escobar-Puentes AA, Palomo I, Rodríguez L, Fuentes E, Villegas-Ochoa MA, González-Aguilar GA, *et al.* Sweet potato (*Ipomoea batatas* L.) phenotypes: from agroindustry to health effects. *Foods*. 2022;11(7):1058. doi:10.3390/foods11071058.
6. Luo Z, Yao Z, Yang Y, Wang Z, Zou H, Zhang X, *et al.* Genetic fingerprint construction and genetic diversity analysis of sweet potato (*Ipomoea batatas*) germplasm resources. *BMC Plant Biol*. 2023;23:355. doi:10.1186/s12870-023-04329-1.
7. Schulz L, Moulton L, Grieger S, White J, Weaver J, Shrestha S, *et al.* Sweetpotato varieties: growing guide. Washington State University, Northwestern Washington Research and Extension Center; 2026. Available from: <https://vegetables.wsu.edu/sweetpotato-varieties/>
8. Akinwale GM, Chalie H, Mwenye OJ, Chipungu F, Demo P, Jogo W, *et al.* The effects of variety selection on the yield and productivity of sweetpotato-legume intercropping options in Malawi. *Front Agron*. 2025;7:1679366. doi:10.3389/fagro.2025.1679366.
9. Morales A, Ma P, Jia Z, Rodríguez D, Vargas IJ, González RE, *et al.* Decoding phenotypic signatures of *Cylas formicarius* Fab. resistance in a global sweetpotato (*Ipomoea batatas* [L.] Lam.) germplasm collection. *Front Plant Sci*. 2025;16:1625810. doi:10.3389/fpls.2025.1625810.
10. Rech C, Silva Junior AD, Galina J, *et al.* Sweet potato leaf trichome density affects the biology and host selection behavior of *Myzus persicae* (Sulzer 1776) (Hemiptera: Aphididae). *Phytoparasitica*. 2025;53:8-15. doi:10.1007/s12600-024-01229-4.
11. Yencho GC, Pecota K, Hancock CN. Ornamental sweetpotato plant named 'Sweet Caroline Sweetheart Light Green'. US Plant Patent No. PP18572 P3. United States Patent and Trademark Office; 2008.
12. Islam S. Sweetpotato (*Ipomoea batatas* L.) leaf: its potential effect on human health and nutrition. *J Food Sci*. 2006;71(2):R13-R121. doi:10.1111/j.1365-2621.2006.tb08912.x.
13. Workayehu T, Mazengia W, Hidoto L. Growth habit, plant density and weed control on weed and root yield of sweet potato (*Ipomoea batatas* L.) at Areka, Southern Ethiopia. *Int J Agric Ext Rural Dev*. 2020;8(9):1-8.
14. Afzal N, Afionis S, Stringer LC, Favretto N, Sakai M, Sakai P. Benefits and trade-offs of smallholder sweet potato cultivation as a pathway toward achieving the sustainable development goals. *Sustainability*. 2021;13(2):1-15. doi:10.3390/su13020552.
15. Laurie SM, Maja MN, Ngoben HM, Du Plooy CP. Effect of different types of mulching and plant spacing on weed control, canopy cover and yield of sweet potato (*Ipomoea batatas* (L.) Lam). *J Exp Agric Int*. 2015;5(5):450-458. doi:10.9734/AJEA/2015/12404.
16. Mondal S, Rutkoski JE, Velu G, Singh PK, Crespo-Herrera LA, Guzmán C, *et al.* Harnessing diversity in wheat to enhance grain yield, climate resilience, disease and insect pest resistance and nutrition through conventional and modern breeding approaches. *Front Plant Sci*. 2016;7:991-1005. doi:10.3389/fpls.2016.00991.
17. Lev-Yadun S. Defensive (anti-herbivory) coloration in land plants. Dordrecht: Springer; 2016.
18. Cooney LJ. Redressing the roles of anthocyanin pigments in vegetative and reproductive organs [thesis]. Wellington: Victoria University of Wellington; 2015. doi:10.26686/wgtn.17009396.v1.
19. Tan SL, Nakatani M, Komaki K. Breeding of sweetpotato. In: Genetic improvement of vegetable crops. p. 333-363. doi:10.1002/9780470376447.ch11.
20. War AR, Paulraj MG, Ahmad T, Buhroo AA, Hussain B, Ignacimuthu S, *et al.* Mechanisms of plant defense against insect herbivores. *Plant Signal Behav*. 2012;7(10):1306-1320. doi:10.4161/psb.21663.
21. Dalin P, Ågren J, Björkman C, Huttunen P, Kärkkäinen K. Leaf trichome formation and plant resistance to herbivory. In: Schaller A, editor. Induced plant resistance to herbivory. Dordrecht: Springer; 2008. p. 89-105. doi:10.1007/978-1-4020-8182-8\_4.
22. Martini F, Sun I, Chen Y. Effects of plant diversity and leaf traits on insect herbivory in plantation and natural forests. *For Ecol Manag*. 2022;509:120085. doi:10.1016/j.foreco.2022.120085.