

## Supplementary Data

**Table S1.** Primers used in this paper.

| Primer ID | Sequence  | Note  |
|-----------|---|---|
| OL13180   | ATGGAAGGTTTTTCACCCTTCTATG                             | Amplification of <i>Glyma.05G134000</i> CDS-F     |
| OL13181   | AGCATTGAAACTCTGGAAGGGC                                | Amplification of <i>Glyma.05G134000</i> CDS-R     |
| OL10628   | GCTACACTACACTCCTCAACATTTA                             | <i>In situ</i> hybridization for <i>GmUFO1</i> -F |
| OL10629   | CTAAGCATTGAAACTCTGGAAGGGC                             | <i>In situ</i> hybridization for <i>GmUFO1</i> -R |
| OL13180   | ATGGAAGGTTTTTCACCCTTCTATGT                            | <i>In situ</i> hybridization for <i>GmUFO2</i> -F |
| OL17146   | TGTAATACGACTCACTATAGGGCAGCATTAAAAC<br>TCTGGAAGGGAAGTG | <i>In situ</i> hybridization for <i>GmUFO2</i> -R |
| OL13183   | CTGTACAAGCATATGATGGAAGGTTTTTCACCCTT<br>CTATGT         | Subcellular localization-F                        |
| OL13184   | GATGAATTCGAGCTCAGCATTGAAACTCTGGAAG<br>GGC             | Subcellular localization-R                        |
| OL15707   | TGAACATGGGTGGCAATTAC                                  | <i>GmAP1a</i> -F for qPCR                         |
| OL15708   | TGTCAAATGCCATACCAAAG                                  | <i>GmAP1a</i> -R for qPCR                         |
| OL15715   | TCTTGCTCCACCCTTCTCTA                                  | <i>GmAP2</i> -F for qPCR                          |
| OL15716   | CGAGTGGAGGAATGTCATGTT                                 | <i>GmAP2</i> -R for qPCR                          |
| OL15717   | GAGGATAGAGAACACCACCAAC                                | <i>GmAP3</i> -F for qPCR                          |
| OL15718   | AAACCTTGGCATCGCATAGA                                  | <i>GmAP3</i> -R for qPCR                          |
| OL15719   | CAAAGAGGAAGAATGGGATCCTTA                              | <i>GmPI04G</i> -F for qPCR                        |
| OL15720   | GGCTGATGTACTCATGCATCT                                 | <i>GmPI04G</i> -R for qPCR                        |
| OL15725   | CAAGAGGATTGAGAACACTACCA                               | <i>GmAG</i> -F for qPCR                           |
| OL15726   | CTGCATCACAAAGCACAGATAAT                               | <i>GmAG</i> -R for qPCR                           |
| OL9129    | ATCTTGACTGAGCGTGGTTATTCC                              | <i>GmActin</i> -F for qPCR                        |
| OL9130    | GCTGGTCCTGGCTGTCTCC                                   | <i>GmActin</i> -R for qPCR                        |
| OL14387   | TTGGGCACGTTTCAGCTTGCTCTTCTCA                          | Knockout test<br><i>Glyma.08G088700</i> -R        |

**Table S2.** Protein physical information of 11 *UFO* genes from nine species.

| Gene                   | Motif | Protein length (aa) | Mol. wt. (Da) | PI (pH) | Instability index | GRAVY  | Arabidopsis ortholog locus | Arabidopsis locus description |
|------------------------|-------|---------------------|---------------|---------|-------------------|--------|----------------------------|-------------------------------|
| AT1G30950.1            | 12    | 442                 | 49,047.32     | 8.62    | 56.21             | 0.001  |                            |                               |
| Glyma.05G134000.1      | 13    | 430                 | 48,378.84     | 8.71    | 47.99             | -0.024 | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |
| Glyma.08G088700.1      | 13    | 440                 | 49,651.21     | 8.6     | 46.36             | -0.05  | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |
| Medtr4g094748.1        | 13    | 444                 | 49,946.73     | 8.98    | 50.88             | -0.017 | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |
| Gorai.002G139700.1     | 9     | 357                 | 39,766.63     | 8.55    | 52.26             | -0.074 | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |
| HORVU7Hr1G10897<br>0.1 | 11    | 438                 | 45,988.19     | 10.34   | 60.45             | 0.224  | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |
| Os06g45460.1           | 11    | 407                 | 42,738.55     | 9.95    | 63.51             | 0.300  | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |
| Phvul.002G188300.1     | 13    | 434                 | 48,843.49     | 8.74    | 49.12             | 0.005  | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |
| Vigun03g153100.1       | 13    | 441                 | 49,447.06     | 8.74    | 48.33             | -0.005 | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |
| Zm00001d046950         | 13    | 433                 | 45,917.02     | 9.79    | 58.42             | 0.184  | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |
| Zm00001d036653         | 13    | 436                 | 46,192.15     | 9.27    | 59.54             | 0.179  | AT1G30950.1                | PROTEIN UNUSUAL FLORAL ORGANS |

**Table S3.** The seeds weight per plant of the wild type and *ufo* mutant lines growing in growth chamber under short day conditions.

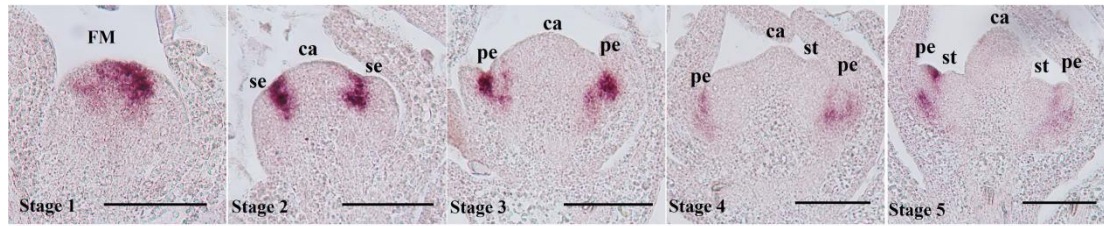
| Genotype          | Line1 (g) | Line2 (g) | Line3 (g) | Mean $\pm$ SD (g) |
|-------------------|-----------|-----------|-----------|-------------------|
| Wild type         | 3.61      | 3.49      | 3.66      | 3.59 $\pm$ 0.06   |
| <i>Gmufo1</i>     | 3.34      | 3.58      | 3.87      | 3.60 $\pm$ 0.19   |
| <i>Gmufo2</i>     | 3.69      | 3.67      | 3.54      | 3.63 $\pm$ 0.06   |
| <i>Gmufo1ufo2</i> | 3.42      | 3.68      | 3.71      | 3.60 $\pm$ 0.11   |

**Table S4.** The pedigree of the transgenic lines in this paper.

| T0 generation |  |  | T1 generation                       |                                       |                                       |
|---------------|--|--|-------------------------------------|---------------------------------------|---------------------------------------|
| Line ID       | <i>UFO1</i><br>genotype<br>(Sequence ID) | <i>UFO2</i><br>genotype<br>(Sequence ID) | Line ID                             | <i>UFO1</i> genotype<br>(Sequence ID) | <i>UFO2</i> genotype<br>(Sequence ID) |
| SP2464        | <i>Heterozygous</i><br>(SG21525)         | <i>Heterozygous</i><br>(SG25372)         | SP2464-1<br>( <i>ufo1-1</i> )       | <i>Heterozygous</i><br>(SG28123)      | WT<br>(SG27198)                       |
|               |  |  | SP2464-2<br>( <i>ufo1-2</i> )       | <i>Heterozygous</i><br>(SG24627)      | WT<br>(SG24928)                       |
|               |  |  | SP2464-3<br>( <i>ufo1-3</i> )       | <i>Heterozygous</i><br>(SG24628)      | WT<br>(SG24929)                       |
|               |  |  | SP2464-4<br>( <i>ufo1-4</i> )       | <i>Heterozygous</i><br>(SG24629)      | WT<br>(SG24930)                       |
|               |  |  | SP2464-5<br>( <i>ufo1-5</i> )       | <i>Heterozygous</i><br>(SG24630)      | WT<br>(SG24931)                       |
|               |  |  | SP2464-6<br>( <i>ufo1-6</i> )       | <i>Heterozygous</i><br>(SG24631)      | WT<br>(SG24932)                       |
|               |  |  | SP2464-7<br>( <i>ufo1-7</i> )       | <i>Heterozygous</i><br>(SG24632)      | WT<br>(SG24933)                       |
|               |  |  | SP2464-9<br>( <i>ufo1-9</i> )       | <i>Heterozygous</i><br>(SG24633)      | WT<br>(SG24934)                       |
|               |  |  | SP2464-15<br>( <i>ufo2-2</i> )      | WT<br>(SG24728)                       | <i>Heterozygous</i><br>(SG28156)      |
|               |  |  | SP2464-16<br>( <i>ufo1ufo2-17</i> ) | <i>Homozygous</i><br>(SG28118)        | <i>Heterozygous</i><br>(SG28157)      |
| SP2465        | <i>Heterozygous</i><br>(SG28105)         | <i>Heterozygous</i><br>(SG24978)         | SP2465-1<br>( <i>ufo2-1</i> )       | WT<br>SG24729                         | <i>Heterozygous</i><br>(SG28153)      |
|               |  |  | SP2465-2<br>( <i>ufo1-15</i> )      | <i>Heterozygous</i><br>(SG28093)      | WT<br>(SG24926)                       |
|               |  |  | SP2465-3<br>( <i>ufo1ufo2-18</i> )  | <i>Heterozygous</i><br>(SG27192)      | <i>Homozygous</i><br>(SG28141)        |
| SP2466        | <i>Heterozygous</i><br>(SG24746)         | <i>Heterozygous</i><br>(SG24977)         | SP2466-1<br>( <i>ufo1ufo2-1</i> )   | <i>Heterozygous</i><br>(SG27193)      | <i>Heterozygous</i><br>(SG28158)      |
|               |  |  | SP2466-2<br>( <i>ufo1-16</i> )      | <i>Heterozygous</i><br>(SG28120)      | WT<br>(SG24925)                       |
|               |  |  | SP2466-3<br>( <i>ufo2-3</i> )       | WT<br>(SG24727)                       | <i>Heterozygous</i><br>(SG28151)      |
| SP2467        | WT<br>(SG25354)                          | <i>Heterozygous</i><br>(SG25370)         | SP2467-1<br>( <i>ufo2-4</i> )       | WT<br>(SG25351)                       | <i>Homozygous</i><br>(SG25368)        |
|               |  |  | SP2467-2<br>( <i>ufo2-5</i> )       | WT<br>(SG25352)                       | <i>Heterozygous</i><br>(SG25369)      |
|               |  |  | SP2467-3<br>( <i>ufo2-6</i> )       | WT<br>(SG25353)                       | <i>Homozygous</i><br>(SG25371)        |

**Table S5.** Comparison of the number of chimeric organs among wild type and *ufo* mutant lines.

| Genotype          | Sepal-petal chimeric organ<br>(chimeric/total) | Petal-stamen chimeric organ<br>(chimeric/total) |
|-------------------|--|---|
| wild type         | 0/30   | 0/30  |
| <i>Gmufo1</i>     | 10/30  | 1/30  |
| <i>Gmudo2</i>     | 0/30   | 0/30  |
| <i>Gmufo1udo2</i> | 24/30  | 3/30  |

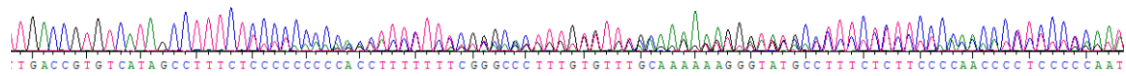


**Figure S1.** *In situ* hybridization of the *GmUFO2* gene in the soybean flower primordium of different development stages. Bar = 100  $\mu$ m.

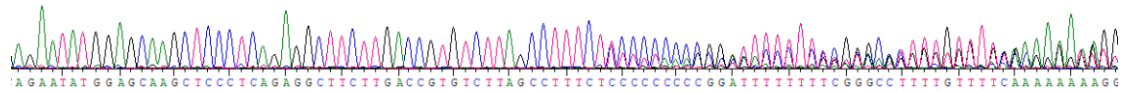
**Figure S2.** The sequencing results of all T0 and T1 mutant lines.

**T0 Generation:**

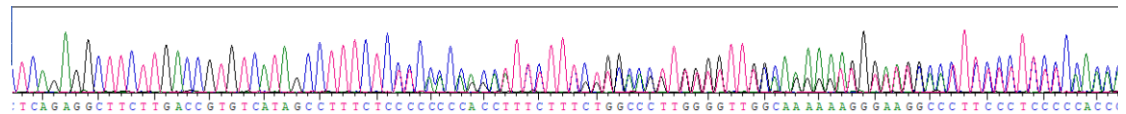
SP2464: *GmUFO1*- SG21525



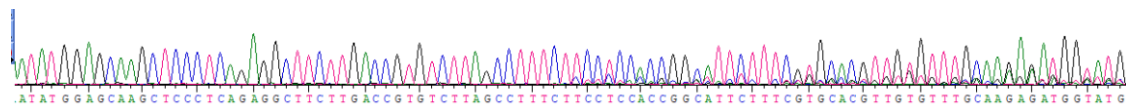
SP2464: *GmUFO2*- SG25372



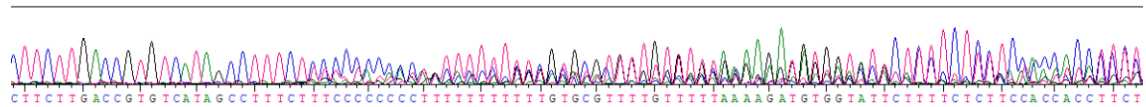
SP2465: *GmUFO1*- SG28105



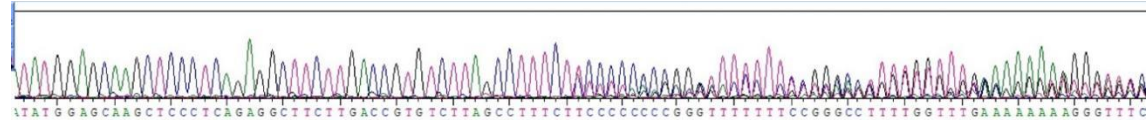
SP2465: *GmUFO2*- SG24978



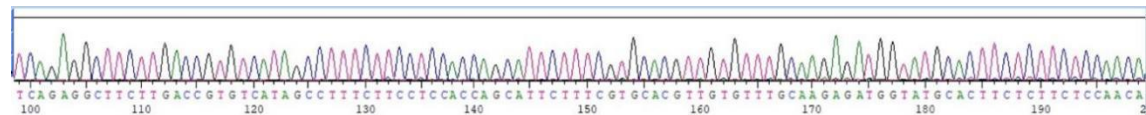
SP2466: *GmUFO1*- SG24746



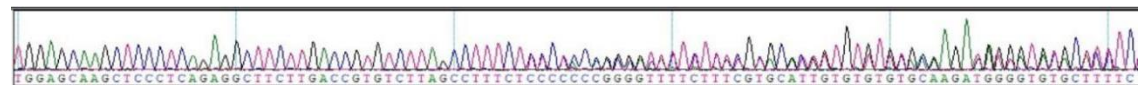
SP2466: *GmUFO2*- SG24977



SP2467: *GmUFO1*- SG25354

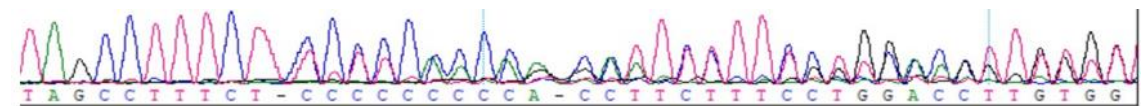


SP2467: *GmUFO2*-SG25370

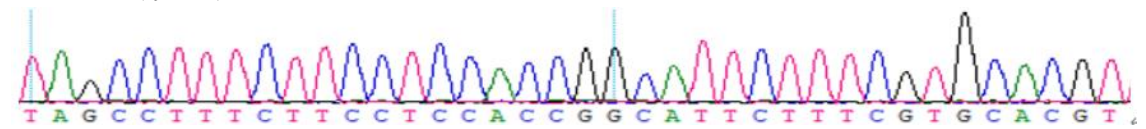


**T1 generation:**

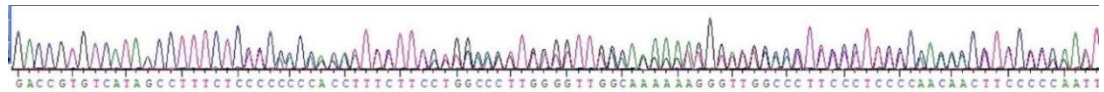
SP2464-1 (*ufo1-1*): *GmUFO1*-SG28123



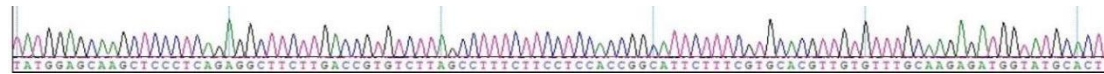
SP2464-1 (*ufo1-1*): *GmUFO2*-SG27198



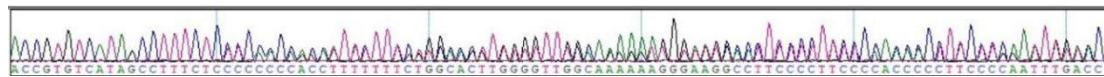
SP2464-2 (*ufo1-2*): *GmUFO1*-SG24627



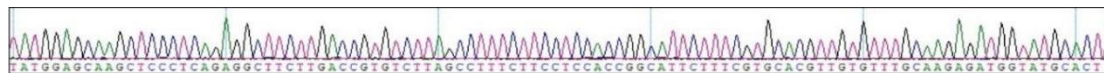
SP2464-2 (*ufo1-2*): *GmUFO2*-SG24928



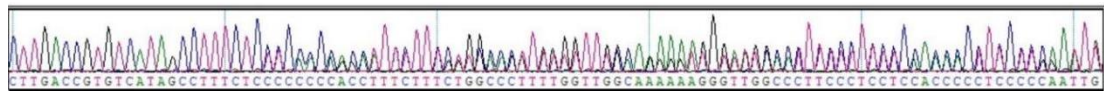
SP2464-3 (*ufo1-3*): *GmUFO1*-SG24628



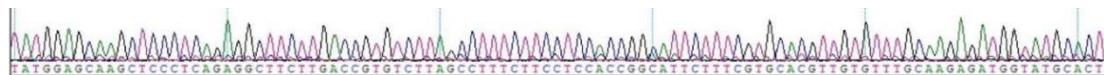
SP2464-3 (*ufo1-3*): *GmUFO2*-SG24929



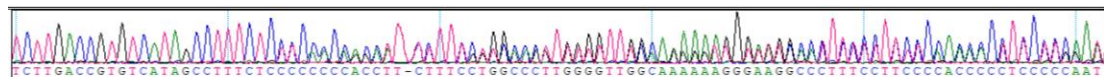
SP2464-4 (*ufo1-4*): *GmUFO1*-SG24629



SP2464-4 (*ufo1-4*): *GmUFO2*-SG24930



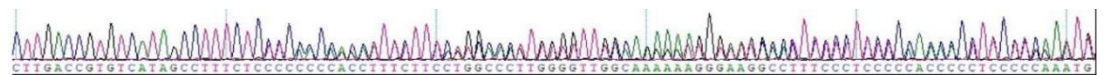
SP2464-5 (*ufo1-5*): *GmUFO1*-SG24630



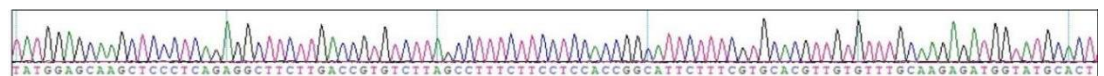
SP2464-5 (*ufo1-5*): *GmUFO2*-SG24931



SP2464-6 (*ufo1-6*): *GmUFO1*-SG24631



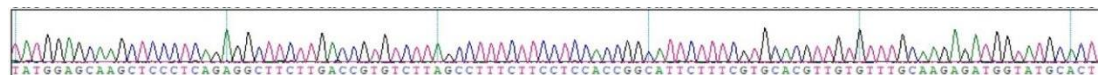
SP2464-6 (*ufo1-6*): *GmUFO2*-SG24932



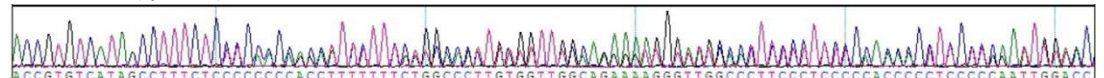
SP2464-7 (*ufo1-7*): *GmUFO1*-SG24632



SP2464-7 (*ufo1-7*): *GmUFO2*-SG24933



SP2464-9 (*ufo1-9*): *GmUFO1*-SG24633

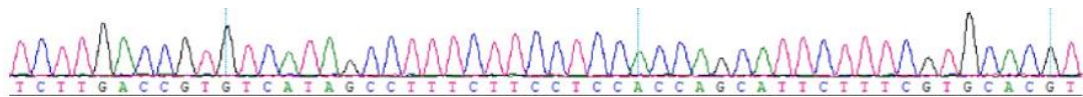


SP2464-9 (*ufo1-9*): *GmUFO2*-SG24934

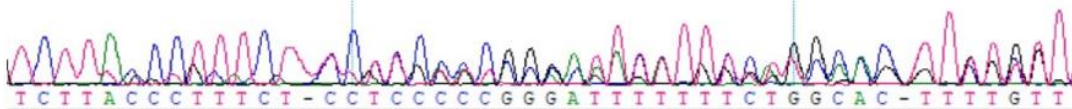




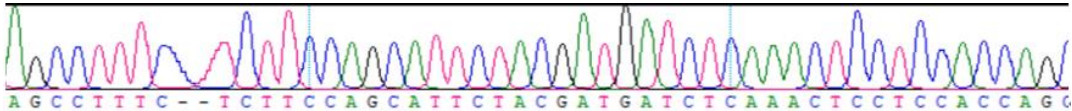
SP2464-15 (*ufo2-2*): *GmUFO1*-SG24728



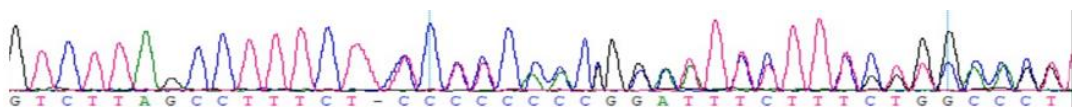
SP2464-15 (*ufo2-2*): *GmUFO2*-SG28156



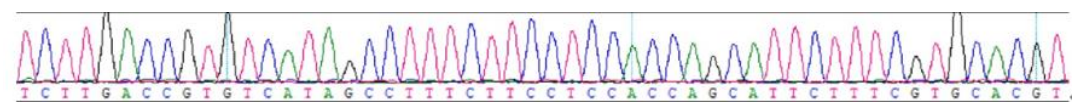
SP2464-16 (*ufo1ufo2-17*): *GmUFO1*-SG28118



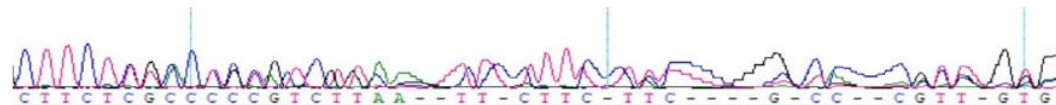
SP2464-16 (*ufo1ufo2-17*): *GmUFO2*-SG28157



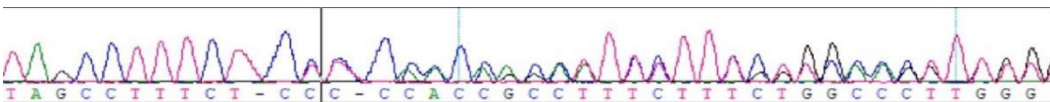
SP2465-1 (*ufo2-1*): *GmUFO1*-SG24729



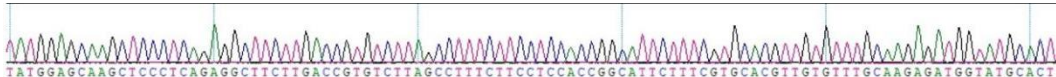
SP2465-1 (*ufo2-1*): *GmUFO2* SG28153



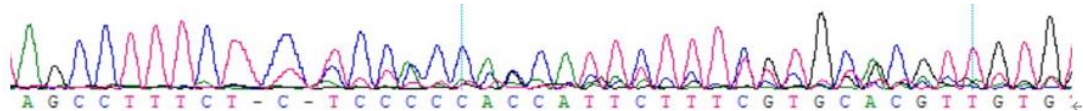
SP2465-2 (*ufo1-15*): *GmUFO1*-SG28093



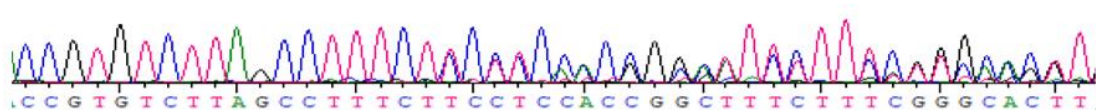
SP2465-2 (*ufo1-15*): *GmUFO2*SG24926



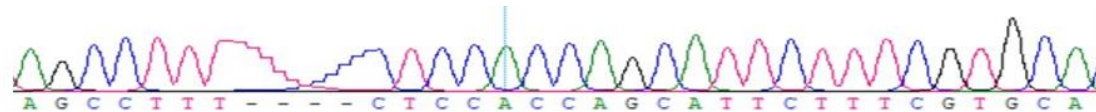
SP2465-3 (*ufo1ufo2-18*): *GmUFO1*-SG27192



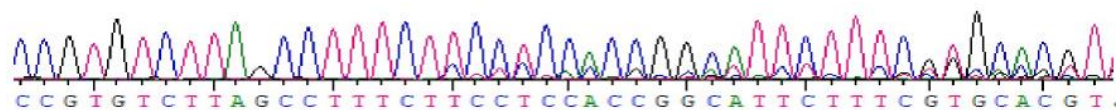
SP2465-3 (*ufo1ufo2-18*): *GmUFO2*SG28141



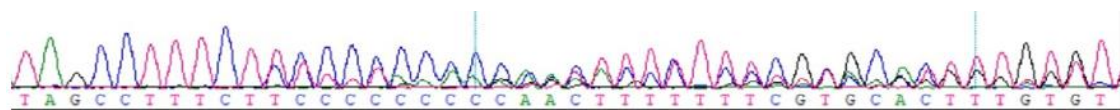
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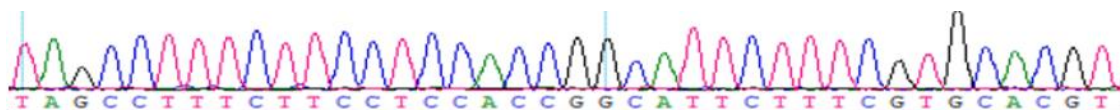
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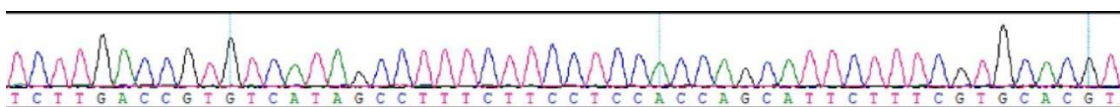
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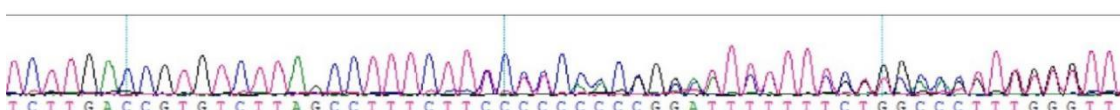
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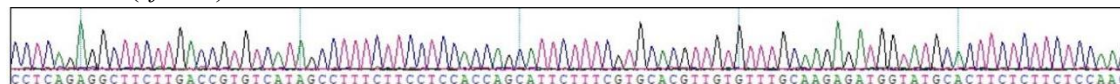
SP2466-3 (*ufo2-3*): *GmUFO1*-SG24727



SP2466-3 (*ufo2-3*): *GmUFO2*SG28151



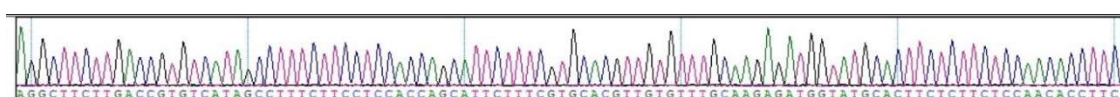
SP2467-1 (*ufo2-4*): *GmUFO1*-SG25351



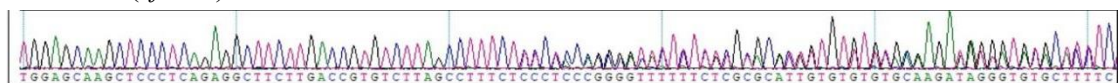
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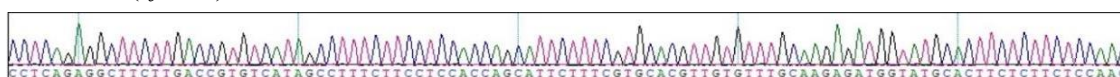
SP2467-2 (*ufo2-5*): *GmUFO1*-SG25352



SP2467-2 (*ufo2-5*): *GmUFO2*SG25369



SP2467-3 (*ufo2-6*): *GmUFO1*-SG25353



SP2467-3 (*ufo2-6*): *GmUFO2*SG25371

