

Automated spraying in Fruit Orchards

Introduction arable farming case

October 31st, Wageningen

Peter Roelofs en Rik de Werd (Applied Plant Research; PPO)



PRAKTIJKONDERZOEK
PLANT & OMGEVING
WAGENINGEN **UR**

Casus arable farming

Challenge: maximize fruit growers income at long term

- **Maximize yield & quality**
 - Yield (kg/ha) x quality (€/kg) = Returns (€/ha)
- **Minimize environmental load**
 - Licence to produce
 - Maximize market opportunities
- **Reduce costs**
 - Labour demand versus fixed costs for investments
 - Autonomous
 - Multi-row sprayers
 - Choice of pesticides



Excursion: fruitgrower Westreenen, Echteld

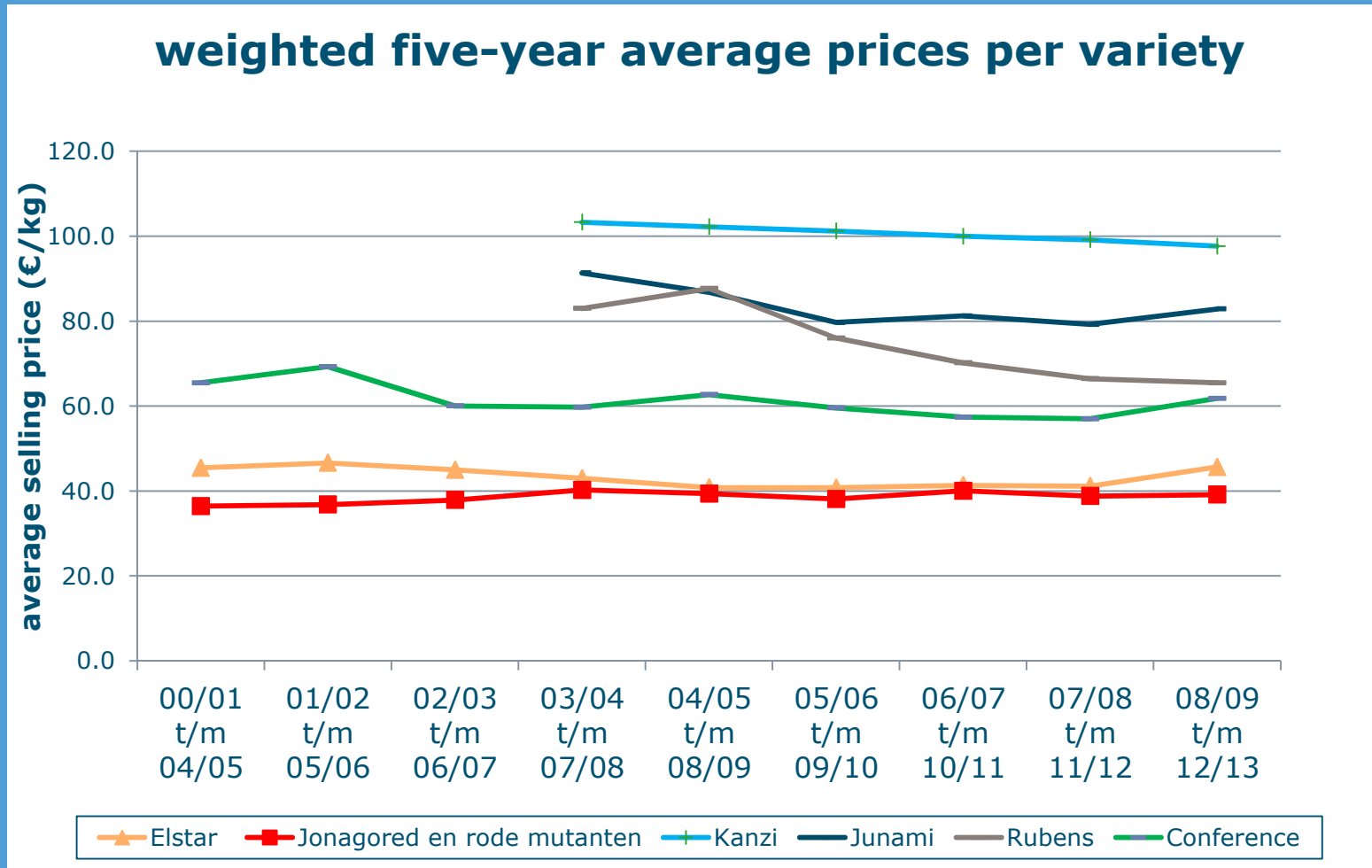
Modern fruit grower (premium supplier of supermarket chain)

“Choice of variety is very important”

- Yield → cost price, returns
- Price (see next slide)
- Storability → supply security, marketability → selling price
- Quality → selling price)
- Susceptibility to diseases → pesticide use → costs and effect on quality → selling price
- Easiness of culture → labour demand → cost price
- Different harvest times → organisation of work
(> 2.500 tons of fruit within 8-9 weeks)



Effect of variety on selling prices



Excursion: Mr. Westreenen, Echteld



Fruit production & sustainability

- Some of the Triple P aspects for a fruit grower:
 - People:
neighbours, employees, consumers, society (village)
 - Planet:
water quality, water availability, eutrophication, biodiversity, waste
 - Profit:
yield, production costs, supply security, farmers income



Content arable farming case

■ Wk 3: Environmental aspects

- Rik de Werd



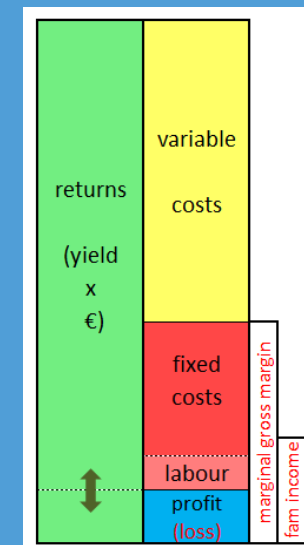
■ Wk 4: Social aspects

- Peter Roelofs



■ Wk 5: Economic aspects

- Peter Roelofs



Environmental aspects:



- Focus on crop protection
 - Emission routes pesticides
 - Diffuse emissions
 - Point emissions
 - Spraying techniques
 - Sprayer types
 - Nozzle types
 - Spraying schedule
 - CLM environmental yardstick



WELKEPFEITENKAART 2018

Appel en Peer

De ecologische voetafdruk

clm  

Indicator	Eenheden	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	1940	1939	1938	1937	1936	1935	1934	1933	1932	1931	1930	1929	1928	1927	1926	1925	1924	1923	1922	1921	1920	1919	1918	1917	1916	1915	1914	1913	1912	1911	1910	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890	1889	1888	1887	1886	1885	1884	1883	1882	1881	1880	1879	1878	1877	1876	1875	1874	1873	1872	1871	1870	1869	1868	1867	1866	1865	1864	1863	1862	1861	1860	1859	1858	1857	1856	1855	1854	1853	1852	1851	1850	1849	1848	1847	1846	1845	1844	1843	1842	1841	1840	1839	1838	1837	1836	1835	1834	1833	1832	1831	1830	1829	1828	1827	1826	1825	1824	1823	1822	1821	1820	1819	1818	1817	1816	1815	1814	1813	1812	1811	1810	1809	1808	1807	1806	1805	1804	1803	1802	1801	1800	1799	1798	1797	1796	1795	1794	1793	1792	1791	1790	1789	1788	1787	1786	1785	1784	1783	1782	1781	1780	1779	1778	1777	1776	1775	1774	1773	1772	1771	1770	1769	1768	1767	1766	1765	1764	1763	1762	1761	1760	1759	1758	1757	1756	1755	1754	1753	1752	1751	1750	1749	1748	1747	1746	1745	1744	1743	1742	1741	1740	1739	1738	1737	1736	1735	1734	1733	1732	1731	1730	1729	1728	1727	1726	1725	1724	1723	1722	1721	1720	1719	1718	1717	1716	1715	1714	1713	1712	1711	1710	1709	1708	1707	1706	1705	1704	1703	1702	1701	1700	1699	1698	1697	1696	1695	1694	1693	1692	1691	1690	1689	1688	1687	1686	1685	1684	1683	1682	1681	1680	1679	1678	1677	1676	1675	1674	1673	1672	1671	1670	1669	1668	1667	1666	1665	1664	1663	1662	1661	1660	1659	1658	1657	1656	1655	1654	1653	1652	1651	1650	1649	1648	1647	1646	1645	1644	1643	1642	1641	1640	1639	1638	1637	1636	1635	1634	1633	1632	1631	1630	1629	1628	1627	1626	1625	1624	1623	1622	1621	1620	1619	1618	1617	1616	1615	1614	1613	1612	1611	1610	1609	1608	1607	1606	1605	1604	1603	1602	1601	1600	1599	1598	1597	1596	1595	1594	1593	1592	1591	1590	1589	1588	1587	1586	1585	1584	1583	1582	1581	1580	1579	1578	1577	1576	1575	1574	1573	1572	1571	1570	1569	1568	1567	1566	1565	1564	1563	1562	1561	1560	1559	1558	1557	1556	1555	1554	1553	1552	1551	1550	1549	1548	1547	1546	1545	1544	1543	1542	1541	1540	1539	1538	1537	1536	1535	1534	1533	1532	1531	1530	1529	1528	1527	1526	1525	1524	1523	1522	1521	1520	1519	1518	1517	1516	1515	1514	1513	1512	1511	1510	1509	1508	1507	1506	1505	1504	1503	1502	1501	1500	1499	1498	1497	1496	1495	1494	1493	1492	1491	1490	1489	1488	1487	1486	1485	1484	1483	1482	1481	1480	1479	1478	1477	1476	1475	1474	1473	1472	1471	1470	1469	1468	1467	1466	1465	1464	1463	1462	1461	1460	1459	1458	1457	1456	1455	1454	1453	1452	1451	1450	1449	1448	1447	1446	1445	1444	1443	1442	1441	1440	1439	1438	1437	1436	1435	1434	1433	1432	1431	1430	1429	1428	1427	1426	1425	1424	1423	1422	1421	1420	1419	1418	1417	1416	1415	1414	1413	1412	1411	1410	1409	1408	1407	1406	1405	1404	1403	1402	1401	1400	1399	1398	1397	1396	1395	1394	1393	1392	1391	1390	1389	1388	1387	1386	1385	1384	1383	1382	1381	1380	1379	1378	1377	1376	1375	1374	1373	1372	1371	1370	1369	1368	1367	1366	1365	1364	1363	1362	1361	1360	1359	1358	1357	1356	1355	1354	1353	1352	1351	1350	1349	1348	1347	1346	1345	1344	1343	1342	1341	1340	1339	1338	1337	1336	1335	1334	1333	1332	1331	1330	1329	1328	1327	1326	1325	1324	1323	1322	1321	1320	1319	1318	1317	1316	1315	1314	1313	1312	1311	1310	1309	1308	1307	1306	1305	1304	1303	1302	1301	1300	1299	1298	1297	1296	1295	1294	1293	1292	1291	1290	1289	1288	1287	1286	1285	1284	1283	1282	1281	1280	1279	1278	1277	1276	1275	1274	1273	1272	1271	1270	1269	1268	1267	1266	1265	1264	1263	1262	1261	1260	1259	1258	1257	1256	1255	1254	1253	1252	1251	1250	1249	1248	1247	1246	1245	1244	1243	1242	1241	1240	1239	1238	1237	1236	1235	1234	1233	1232	1231	1230	1229	1228	1227	1226	1225	1224	1223	1222	1221	1220	1219	1218	1217	1216	1215	1214	1213	1212	1211	1210	1209	1208	1207	1206	1205	1204	1203	1202	1201	1200	1199	1198	1197	1196	1195	1194	1193	1192	1191	1190	1189	1188	1187	1186	1185	1184	1183	1182	1181	1180	1179	1178	1177	1176	1175	1174	1173	1172	1171	1170	1169	1168	1167	1166	1165	1164	1163	1162	1161	1160	1159	1158	1157	1156	1155	1154	1153	1152	1151	1150	1149	1148	1147	1146	1145	1144	1143	1142	1141	1140	1139	1138	1137	1136	1135	1134	1133	1132	1131	1130	1129	1128	1127	1126	1125	1124	1123	1122	1121	1120	1119	1118	1117	1116	1115	1114	1113	1112	1111	1110	1109	1108	1107	1106	1105	1104	1103	1102	1101	1100	1099	1098	1097	1096	1095	1094	1093	1092	1091	1090	1089	1088	1087	1086	1085	1084	1083	1082	1081	1080	1079	1078	1077	1076	1075	1074	1073	1072	1071	1070	1069	1068	1067	1066	1065	1064	1063	1062	1061	1060	1059	1058	1057	1056	1055	1054	1053	1052	1051	1050	1049	1048	1047	1046	1045	1044	1043	1042	1041	1040	1039	1038	1037	1036	1035	1034	1033	1032	1031	1030	1029	1028	1027	1026	1025	1024	1023	1022	1021	1020	1019	1018	1017	1016	1015	1014	1013	1012	1011
-----------	----------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

Environmental aspects:

MILIEU-EFFECTENKAART 2010												
Appel en Peer												
Bij verschillende driftpercentages												
Middel	Toe- passings- tijdstip	Advies- dosering	Kg actieve stof	Milieu-effecten					Nuttige organismen		Doel belangrijkste plaag/ziekte	Veiligheids- termijn dagen
				Grondwater		Waterleven		Luofht	Be- stui- vers	Be- strij- ders		
				organische stofklassen		voor 1 mei (drift)	na 1 mei (drift)					
				1,5-3%	3-8%	3,6% *	1,6% *					
		kg ha of l/ha	kg a.s./ha	MBP	MBP	MBP	MBP	kg a.s./ha				
Organische stoffen												
Admiral	mt-aug	0,1	0,07	250	7	0	0	0,00	C	C	Luisen, wantsen en kevers	14
Admiral	sept-feb	0,1	0,07	250	14	0	0	0,00	C	C	Luisen en kevers	14
Apollo	mt-aug	0,3	0,15	0	0	147	30	0,00	A	A	Frutspintmijt	2
Bacillus thuringiensis (o.a. Xen-Tari)	mt-aug	1	0,54	0	0	0	0	0,00	A	A	Rupsen (Wintervlinder)	7
Calypso	jan-dec	0,25	0,12	1	0	15	5	0,00	B	B	Wantsen, luisen en kevers	14
Cydia pomonella granulosa virus (Mader plus, Cyd-X)	mt-aug	1	0,00	0	0	0	0	0,00	?	A	Frutmot	1
Cydia pomonella granulosa virus (Mader plus, Cyd-X)	mt-aug	0,1	0,00	0	0	0	0	0,00	?	A	Frutmot	1
Decis EC	mt-aug	0,2	0,01	0	0	119	15	0,00	B	C	Perenbladvis, rupsen, luisen en wantsen	7
Dimilin	mt-aug	0,3	0,08	3	3	1	15	0,00	C	B	Rupsen	14
Envidor	mt-aug	0,4	0,10	8	2	0	0	0,01	?	?	Perenbladvis, mijten en schildkruis	14
Exomone C	mt-aug	25 stuks	0,00	0	0	0	0	0,00	?	?	Frutmot	nvt
Gazelle	mt-aug	0,25	0,05	3	0	14	6	0,00	B	C	Luisen, wantsen en kevers	14
Insegar 25 WG	mt-aug	0,3	0,08	0	0	15	41	0,00	A	B	Frutmot en bladrollers (rupsen)	21
Kohlnor 70 WG	mt-aug	0,1	0,07	250	7	0	0	0,00	C	C	Luisen, wantsen en kevers	14
Masai 25 WG	mt-aug	0,4	0,10	0	0	82	15	0,00	A	B	Frutspintmijt	7
minerale olie (o.a. Oile-H, 11 E Oile)	mt-aug	30	24,00	150	0	0	0	3,12	A	A	Wantsen en luisen (eieren)	voor bloei
Neemazol 1% ²	mt-aug	3	0,03	0	0	0	0	0,00	B	A	Luisen	nvt
Nesoron spuitpoeder	mt-aug	0,4	0,04	0	0	0	0	0,00	A	A	Frutspintmijt	28
Primor	mt-aug	0,5	0,25	125	2	193	10	0,09	A	A	Luisen	7
RAK 3	mt-aug	500 ampullen	0,04	0	0	0	0	0,04	?	?	Frutmot	nvt
Runner	mt-aug	0,4	0,10	88	4	0	0	0,01	A	A	Frutmot en bladrollers (rupsen)	14
Steward	mt-aug	0,17	0,05	1	0	7	3	0,00	B	B	Frutmot en bladrollers (rupsen)	7
Teppeli	jan-dec	0,14	0,07	0	0	0	0	0,00	A	A	Luisen	24
Vertimec Gold	mt-aug	0,75	0,01	0	0	3	1	0,01	B	C	Frutspintmijt en Perenbladvis	28
Organische stoffen												
				1% drift *				1% drift *				
2,4 D, Dicamba, MCPA (o.a. Aamla) ^{1,2,3}	mt-aug	4	1,86	325	66	25	25	0,00	?	?	Aanwezige onkruiden	nvt
amitrol (o.a. Weedazol)	mt-aug	10	2,50	0	0	10	10	0,40	?	?	Aanwezige onkruiden + zaadonkruiden	nvt
amitrol (o.a. Weedazol)	sept-feb	10	2,50	0	0	10	10	0,25	?	?	Aanwezige onkruiden + zaadonkruiden	nvt
Fusilade Max	mt-aug	3	0,38	305	54	3	3	0,06	?	?	Aanwezige onkruiden	28
glufosinaat-ammonium (o.a. Finale SL 14, Basta 200)	mt-aug	5	0,75	145	145	0	0	0,03	?	?	Aanwezige onkruiden	nvt
glyphosaat (o.a. Roundup)	mt-aug	5	1,80	0	0	10	10	0,00	?	A	Aanwezige onkruiden	28

General: Effects of technique versus effects of spraying scedule!



Social aspects:

■ Focus on labour

- Labour demand
 - Effects of mechanization/automation (spraying, pruning)
- Techniques for harvesting

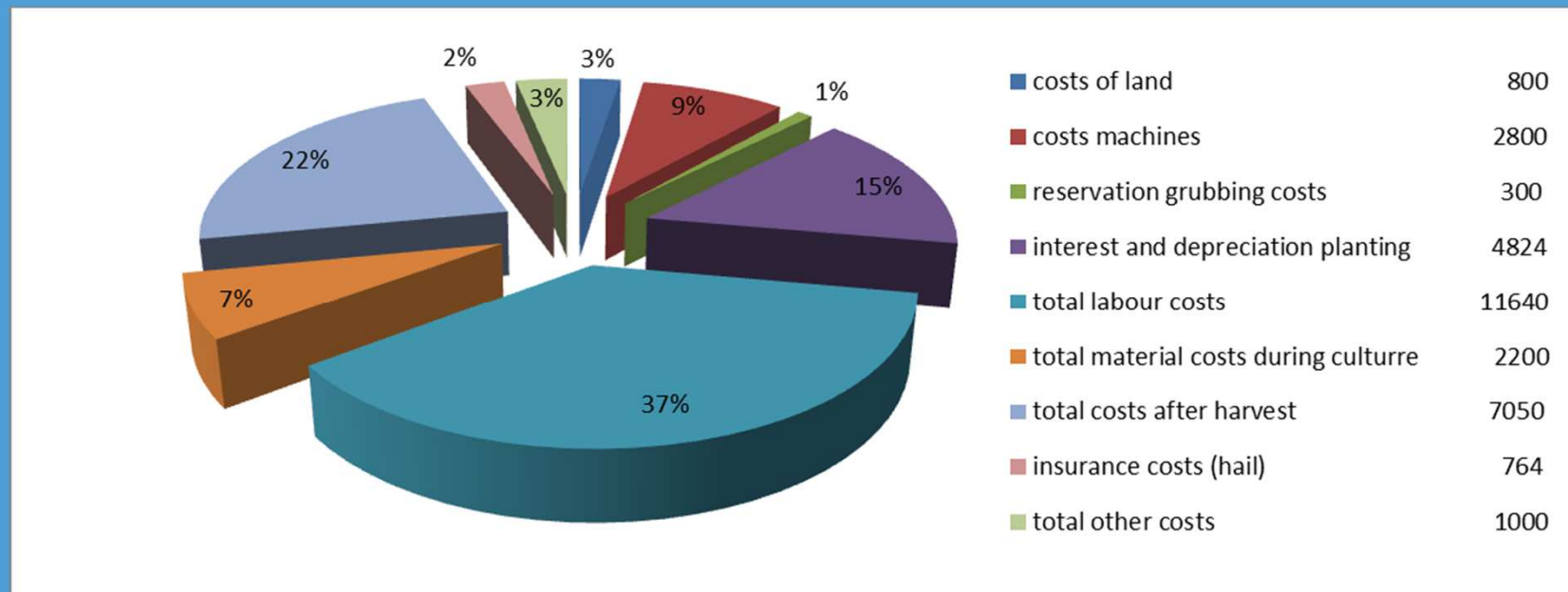


- Labour conditions
(bending, twisting, lifting, etc)



Economic aspects:

■ Focus on labour



Economic aspects:

- Labour costs and labour liability affect mechanization



- (costs per hour) x (# hours) = (processing costs)
- Social aspects



Economic aspects:

■ Focus on labour

- Autonomous spraying
- Multi-row sprayers
- Mechanical thinning
- Mechanical pruning



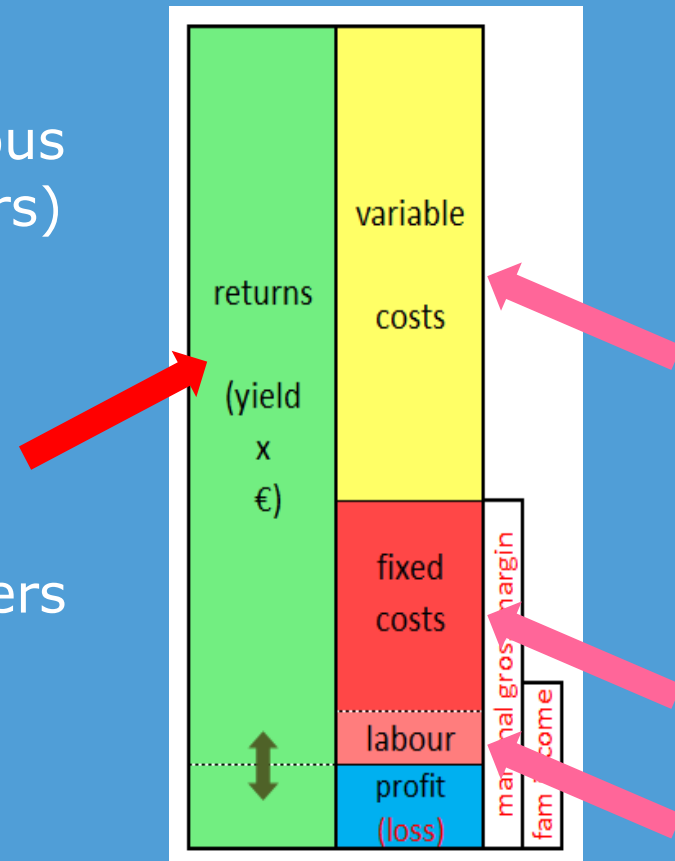
Autonomous spraying with KWH-CDH sprayer



Economic aspects:

■ Economic evaluation

- Effects of spraying technique (multi-row sprayers, autonomous sprayers, drift reducing sprayers) on farmers income
- Effects of spraying scheme on farmers income
- Effects of lower selling prices, due to more residues, on farmers income.



What is the best sustainable choice for fruitgrower Westreenen?

Considering:

- Environmental aspects
- Social aspects
- Economical aspects

